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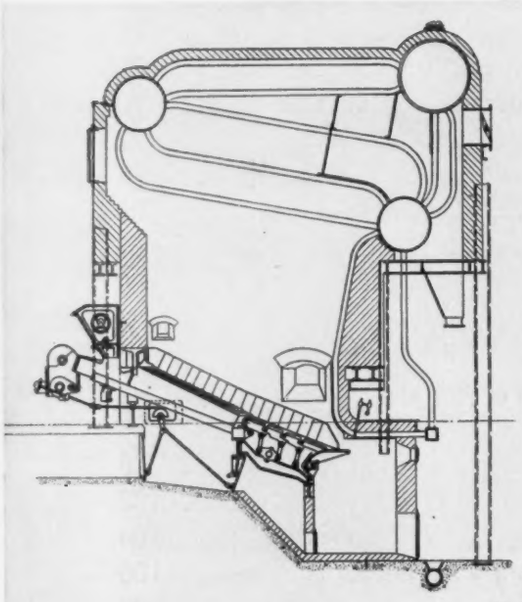
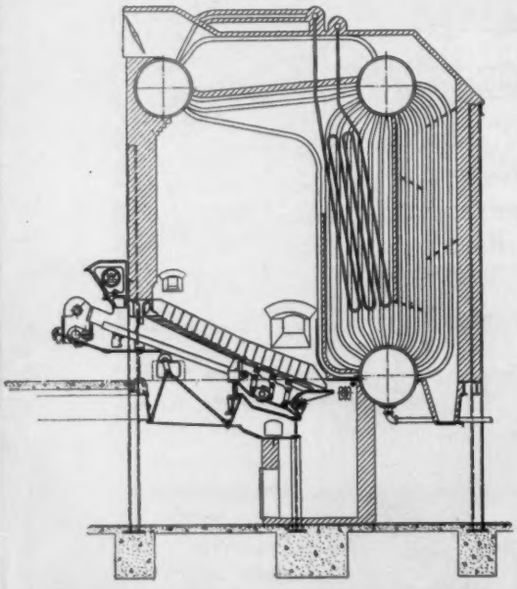




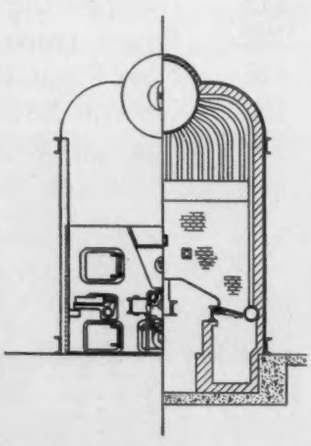
Link-Grate STOKERS FOR QUICK PLANT EXPANSION..REQUIRE MINIMUM TIME FOR NEW INSTALLATION OR CHANGE-OVER

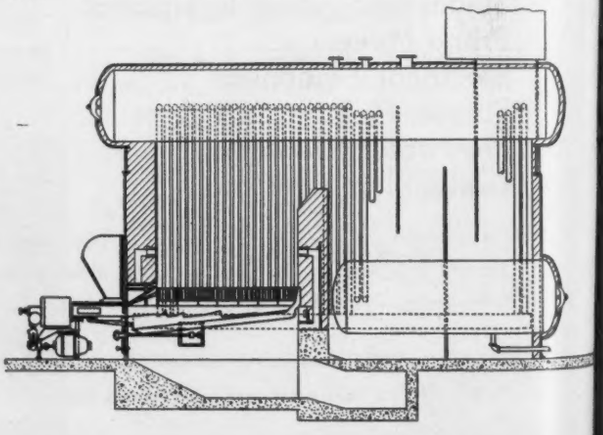
Westinghouse Link-Grate Stokers are made in various widths and lengths to fit readily into the combustion chambers of boilers. Both multiple retort and single retort stokers are partially assembled at the factory and require only minimum installation work at the boiler.

PARTIAL SHOP ASSEMBLY AND BASIC DESIGN of Link-Grate stokers enable you to install new capacity at a lower expenditure of time and money. For example, the single retort stoker requires no special tile or arch work, no furnace changes, no deep excavation. The unit retort type of construction of the multiple retort stoker makes assembly easy and quick.

THE LINK-GRATE is the *plus* feature that gives you higher combustion efficiency with Westinghouse Stokers. It is a sturdy structure, carefully machined, with balanced loads that require little drive power. The Link-Grate section may be assembled quickly without complicated adjustments. Frames are self-supporting.

Besides being easier to install, Link-Grate stokers will save you money in fuel bills and maintenance expense.





Westinghouse

Power for the Battle of Production

Kilowatts Win the Modern War

Today's wars are won by the side with the most and best fuel-fed fighting machines, backed by the most productive factories, powered with the most kilowatts

ONCE WAR WAS SIMPLE. Offensive arms were the sword and spear, defensive the shield and armor. Armies traveled light, living on the countryside. Wars were won or lost on the individual battlefield, and it was a rare conflict that lasted more than a day.

Early use of projectiles changed this pattern but little. Caesar reports the firing of 30,000 arrows into a single fort at the siege of Durazzo, but arrows could be readily replenished by an army in the field. The catapults and ballista of his time used stone shot and required no gunpowder.

The first great artillerist was Mohammed II, whose bombards threw stone shot 30 in. in diameter, weighing 1500 lb. Sixty oxen dragged each of these monsters, with 200 men to keep them in place and 200 more to level the road. With thirteen great bombards and 56 smaller cannon, Mohammed laid down the world's first great bombardment, at the siege of Constantinople (1453).

Just as Mohammed II recognized the value of the siege gun, so Gustavus Adolphus of Sweden, creator of modern warfare, gaged the value of the field gun. By cutting down its length, lightening the carriage, and standardizing on a few calibres, he made it a truly mobile weapon. At Breitenfeld and Lutzen (1631), Gustavus' artillery won the day and established the dominance of fire power.

"It is with artillery that war is made," said Napoleon, and his massed guns shook Europe. In his time the number of French cannon grew to almost 30,000 and at the battle of Leipzig, 175,000 shot were fired. In contrast to the steady growth in importance of firepower and the need for equipment and ammunition, there had been, up to this time, no improvement in supply of food and forage.

Although the ancient Roman and Byzantine armies had functioned with efficient supply arrangements, and in later years, Isabella of Spain had been known as one of the ablest quartermasters in his-

tory, armies of the 17th and 18th centuries, employing huge masses of cavalry, were definitely limited in size by the difficulty of securing forage for the horses. Leading the armies of a country impoverished by revolution, Napoleon carried on the tradition of feeding his men from the countryside, and this was to lead to his undoing.

It is significant that Napoleon's conqueror, Wellington, was the first great modern general to fully appreciate the importance of supply to an army in the field. The step-by-step defeat of the French armies in the Spanish Peninsula began in the terrible winter when its men starved, froze and died of disease in the arid and poverty-stricken plains of Portugal while the British, behind the fortified lines of Torres Vedras, supplied by ship from England, gathered strength for the long campaign ahead.

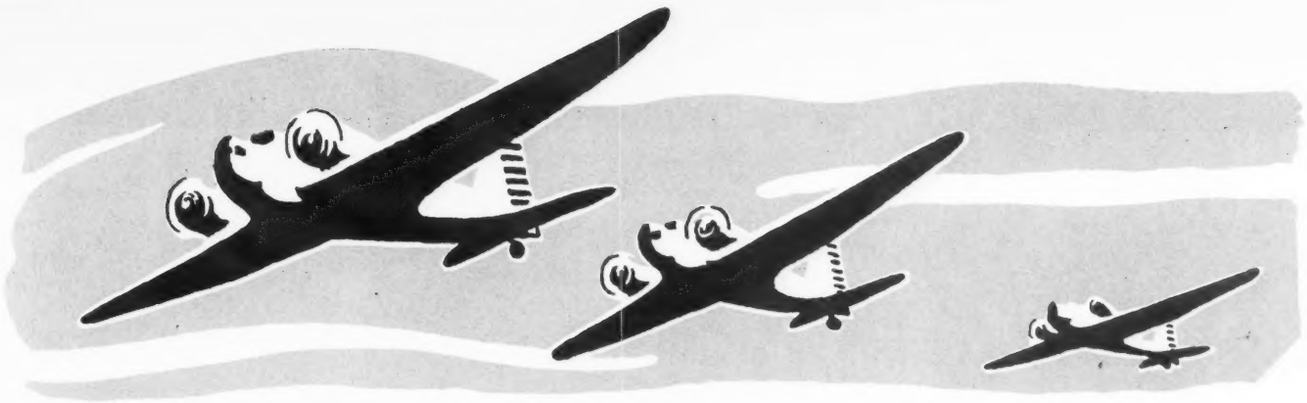
Again the weakness of trying to feed an army on the countryside was brought home to Napoleon by the terrible courage of the Russian peasants, who laid waste their homes and fields in the face of the French advance on Moscow in 1812. Of the 680,000 men who started the campaign, less than 5000 returned to France; the Russian winter accounted for more casualties than the bloody battles of Borodino and Beresina.

While neglect of supply where it was needed played a fatal part in Napoleon's downfall, economic and industrial power made it possible for the British to survive and win ultimate victory. For the first time in history a single nation possessed seapower enough to blockade a continent (219 ships of the line and 296 frigates in 1815). It was the genius of Watt, Boulton, Maudslay, Whitworth, Wilkinson and the other great "master mechanics" of this period that gave England the industrial power that won the long and unequal struggle.

Mass production, later to be epitomized in Detroit, had its real birth in the British shipyards of the Napoleonic era and in the New England gunshops of Whitney and North. What is surely one of the first applications of machine manufacture, a device to speed production of the thousands of rigging blocks needed for British men-of-war, grew out of the urgent need to maintain Nelson's "farflung line of ships" that confined Napoleon to the Continent.

Schoolboys remember Eli Whitney as the inventor of the cotton gin, and never hear of Simeon North, yet these two men, at virtually the same time, introduced the principle of interchangeable manufacture, basic to mass production. By means of cleverly designed jigs and fixures they not only multiplied the rate of production but insured the interchangeability of every gun part.

In a dramatic test, Whitney sold his idea to President Jefferson and thus secured a contract to build muskets for the newly formed U. S. Army. Before the eyes of witnesses, Whitney disassembled ten muskets selected at random and scrambled the parts. In the face of the expressed doubts of all present, the guns were quickly reassembled from parts picked casually from the pile. The parts fitted



perfectly, the guns worked, and the idea of interchangeable manufacture was established.

If any doubt remained that industry and the military were partners, our own Civil War proved the point to the hilt. In the grip of a blockade, the agricultural South was forced to desperate expedients to supply its fighting men. Every compost heap was mobilized to supply bitterly needed nitre for powder-making and the Bahamas swarmed with blockade runners who grew rich smuggling the European supplies that formed the lifeblood of the South's war effort. But when Grant won the battle of Chattanooga, the main rail connections with the strategic ports of New Orleans, Mobile, Pensacola, Savannah and Charleston were cut. Cut off by Union seapower, the impoverished South could no longer clothe, feed, and arm its troops, rated "the finest individual fighters the world has ever seen".

Not until the World War did a single struggle produce so many military inventions as did the Civil War. Magazine rifles, machine-guns, hand-grenades, torpedoes and submarine mines were tried out. Armored trains were used and Southern beauties sacrificed silk dresses to make an observation balloon. The Monitor and Merrimac sounded the knell of wooden ships. Mechanization had entered warfare with a vengeance.

World War I carried on these trends. When the early prophecies of a "short war" faded out at the end of 1914, the giant armies sank into a deadlock in the Flanders mud. More men, more cannon, more shells was the cry, and factories all over the world worked night and day to feed the hungry war machines. Close to 10,000,000 men fought on the Western front during the final days of the war and in a single offensive 3000 guns poured 4,500,000 shells on one sector of the German defenses.

World War I was the high tide of one kind of warfare – firepower, with industry to implement it, had become the dominant military religion. To beat the devastation of the barrage and the frightful efficiency of the machine-gun, men crawled into holes like rats and maneuvre became a lost art.

Yet when this warfare was at its height, a new and more terrible type was born. On November 20th, in a thick gray morning mist, 380 tanks smashed into the famous Hindenburg line, producing a "breakthrough" that might have brought the war to an earlier end, had it been exploited to the full. The tank proved, by German verdict, the most dangerous and decisive weapon used against them.

So began the shift from war based on guns and shell to war based on gasoline. The Germans and Italians, and later the Russians, all grasped the tremendous possibilities in the idea of putting an army, with its weapons and defenses, on wheels. During the years of the "peace", the military brains of Europe devised and improved the new mobile weapons. Motorizing infantry and supply led to the "panzer" division, final expression of gasoline warfare.

At last war had become entirely mechanized. As events have since proved, the importance of the soldier has diminished, and that of the industrial worker increased. A modern army is no longer men and guns, it is men and machines—steel, aluminum, engines, and, above all, oil. And to an even greater extent, warfare depends on supply—The Battle of the Atlantic wages incessantly to maintain the lifeline between American industry and England.

To put an army in the field today requires the highest kind of industrial development, and to keep it there requires grim concentration on the business of production. Not for nothing has the present struggle been called "The Battle of Production". Ultimate victory will go to the side with the most oil wells and refineries, the most steel mills, the most machine tools, and the most power.

As the essential partner in every stage of the industrial process, from raw material to finished munitions, the strategic importance of power to a country at war cannot be over-estimated.

For better or worse, the United States has pitted its industrial capacity against the Nazi war machine. How can power men and the power industry meet the challenge implicit in this Battle of Production? The answer requires a realistic examination of the power resources that were ours when the conflict began, of the loads to be expected as the struggle continues, of the plans made to meet these new stresses and strains, and of the resources of fuel and manpower needed to keep the kilowatts coming.

Using every dependable source of information, POWER here presents these facts, a solid foundation for the engineer's defense job.

America Builds World's Largest Power Plant

50,000,000 Hp Turned Prewar Industry's Wheels

Power Supply for Industry — 1939

Industry Group	Aggregate Horsepower	Prime Movers, Horsepower	Electric Motors Driven by Purchased Energy		Electric Motors Driven by Plant Energy		Electric Generators, Kilowatts	Electric Energy in Thousands of Kilowatthours		
			Number	Horsepower	Number	Horsepower		Generated	Sold	Purchased
All industries—total	**51,154,523**	**21,266,557**	**4,138,169**	**29,887,966**	**1,224,637**	**16,078,658**	**9,674,934**	**28,749,940**	**2,922,940**	**45,040,867**
Food and kindred products	5,641,424	1,985,395	610,645	3,656,029	122,115	996,127	720,413	1,469,504	79,809	4,998,209
Tobacco manufactures	100,511	49,665	22,248	50,846	6,878	29,815	31,512	52,666	3,642	65,675
Textile-mill products	3,666,365	1,441,001	503,372	2,225,364	183,040	955,252	917,169	1,773,975	171,556	5,197,651
Apparel and other finished products	249,019	25,257	215,081	223,762	5,917	11,957	14,605	12,379	1,298	345,216
Lumber and timber basic products	2,604,134	1,687,664	68,911	916,470	52,664	792,655	531,935	896,293	184,833	526,117
Finished lumber products	1,350,801	406,360	139,968	944,441	53,861	305,852	181,084	190,704	5,525	417,938
Paper and allied products	4,129,203	2,792,900	116,367	1,336,303	101,388	2,162,116	1,546,870	6,347,237	211,864	3,258,228
Printing, publishing, etc	771,673	53,679	308,713	717,994	10,805	45,909	33,088	49,684	3,217	812,741
Chemicals and allied products	4,062,680	2,106,028	189,066	1,956,652	137,449	1,250,392	1,103,147	4,433,408	176,215	5,554,226
Products of petroleum and coal	2,404,898	1,386,007	40,788	1,018,891	26,970	751,474	406,946	1,646,097	115,180	1,909,267
Rubber products	989,927	288,170	58,161	701,757	18,536	281,575	167,248	507,633	5,007	1,081,811
Leather and leather products	460,030	150,166	95,913	309,864	19,498	108,258	88,972	135,882	21,177	287,149
Stone, clay, and glass products	3,036,671	947,183	148,254	2,089,488	41,390	901,558	517,256	1,627,283	34,182	3,258,523
Iron and steel products (except machy)	12,652,676	5,374,736	490,170	7,277,940	159,916	5,070,459	1,877,701	5,948,991	1,363,682	7,652,601
Nonferrous metals and products	1,884,464	671,692	136,984	1,212,772	26,318	341,218	412,526	1,473,782	311,771	4,793,569
Electrical machinery	1,019,323	354,449	186,174	664,874	63,786	352,003	248,697	470,058	53,294	1,014,843
Machinery (except electrical)	2,611,997	434,109	383,399	2,177,888	72,996	568,528	253,494	353,291	10,799	1,642,923
Automobiles and auto equipment	2,246,966	853,672	230,262	1,393,294	85,386	838,069	502,339	1,174,420	128,347	1,421,310
Transport equipment (except auto)	706,663	131,924	61,605	574,739	16,845	251,522	60,641	67,203	4,435	419,460
Miscellaneous industries	565,098	126,500	132,088	438,598	18,879	63,919	59,291	119,450	37,107	383,410

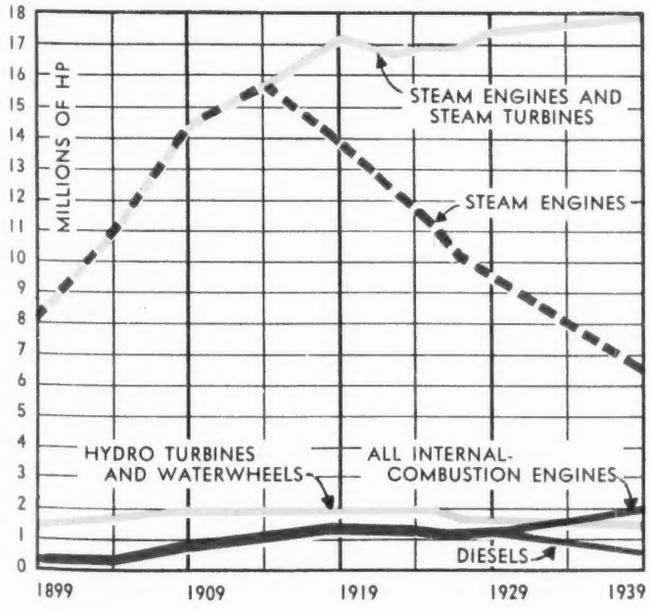
TWO YEARS AGO, America's puny armament industry was given the task of out-producing the Nazi war machine. Beating our plowshares into swords has turned out to be a bigger job than the experts thought, but even the most pessimistic observers draw hope from the fact that this country has the most highly mechanized industrial establishment the world has ever known.

On these two and the following two pages are the facts of just how much power industry had when Hitler ran roughshod over Poland. Subsequently, we will show how power facilities have and will expand to meet the emergency. Here, however, is the basis for any sound plan of strategy—what does the nation have to start the job. Before the general deploys his troops, he must know how many he has and what they can do.

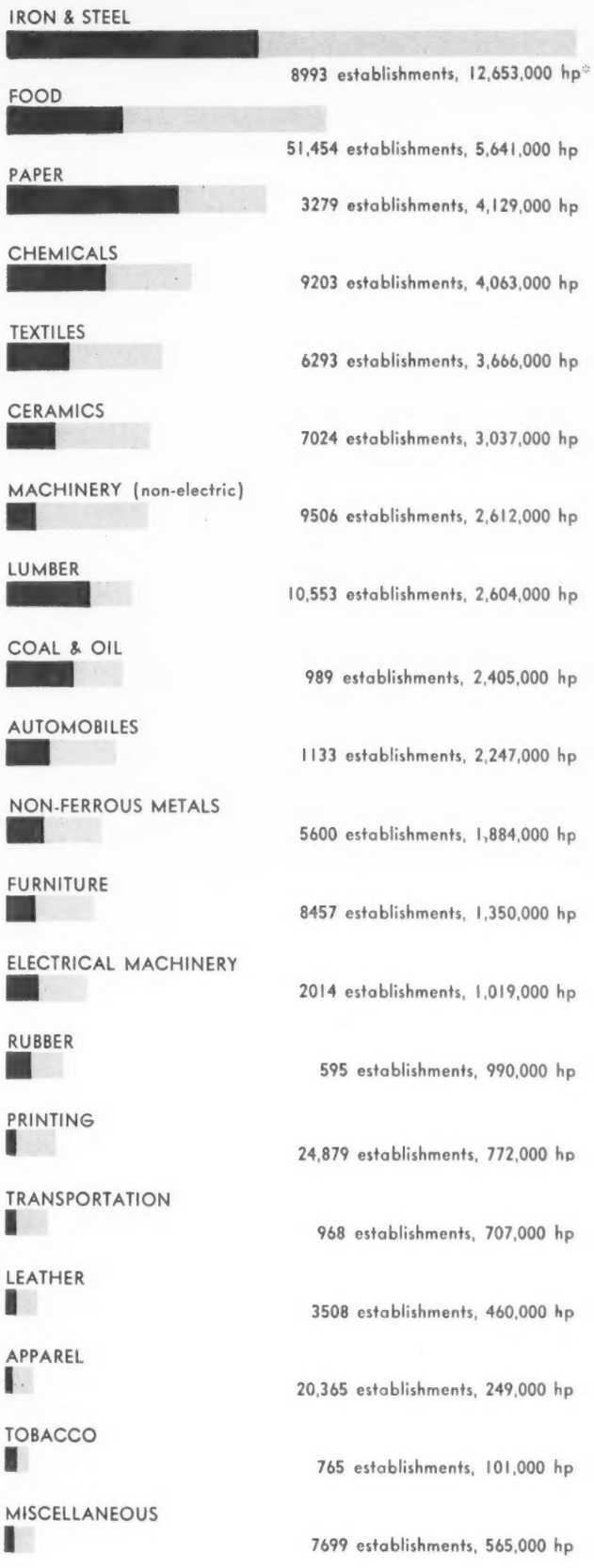
Of the twenty industry groups listed in the 1939 census, blast furnaces and steel mills eat up more kilowatts than any other classification. Steel was one of the first industries to rise from 70% production level to 99% effective output. Existing mills, now using all the power-utilization equipment they have, couldn't increase production of steel, and consequently power use, much above present levels even if their backlog of orders were doubled.

The lesson to be learned is that America needs all the production possible from existing plants, needs the first day's output of new plants as quickly as possible, and requires every succeeding day's production regularly from the first day on if this country is to win the battle of production.

Prime-Mover Horsepower in Manufacturing Establishments



Distribution of Power Use



* Hp figures are sum of prime-mover and motor hp

Four times more fuel is delivered to manufacturing plants, steel mills, cement kilns, coke and glass works than to the nation's central power stations. Calculated as equivalent tons of coal, industry required 281 million tons in 1939 compared to about 60 million for public utilities. Much more fuel is now required for both.

Not all this fuel is burned to make steam. Large quantities of coal go to make coke, in turn sold to steel mills. Petroleum refineries burn their own high-volatile distillates and waste products directly in stills. Cement kilns are direct fired, although waste-heat boilers are utilized.

Fuel is required by every industry. Some need much coal, gas or oil, but little electric power. For others, such as clothing manufacturers, the situation is exactly opposite. A few, like the pulp and paper group, enjoy a neat balance between power and heat needs.

Industries that require much steam or heat for process must expand their power plants along with any production-capacity increase. Powder-manufacturing establishments, for example—we had only a few of importance in 1939—are new members of the heat-consuming chemical industry and their power facilities have been built alongside and at the same time as the production equipment was installed.

Industries that use great amounts of power—aluminum and magnesium reduction, copper electrolysis—have searched out locations convenient for hydroelectric energy, for reasons of economy. This does not mean aluminum cannot be made from steam-generated power, but merely that in peace time it is less expensive to move the production equipment and raw materials to where energy can be purchased at low yearly cost than to set up power-generating facilities for burning fuel.

In this respect, electrochemical and electrometallurgical industries are hard put to find large blocks of low-cost surplus power. When the emergency reaches the acute stage, the "low-cost" requirement may be dropped, and the most expedient means of supply used.

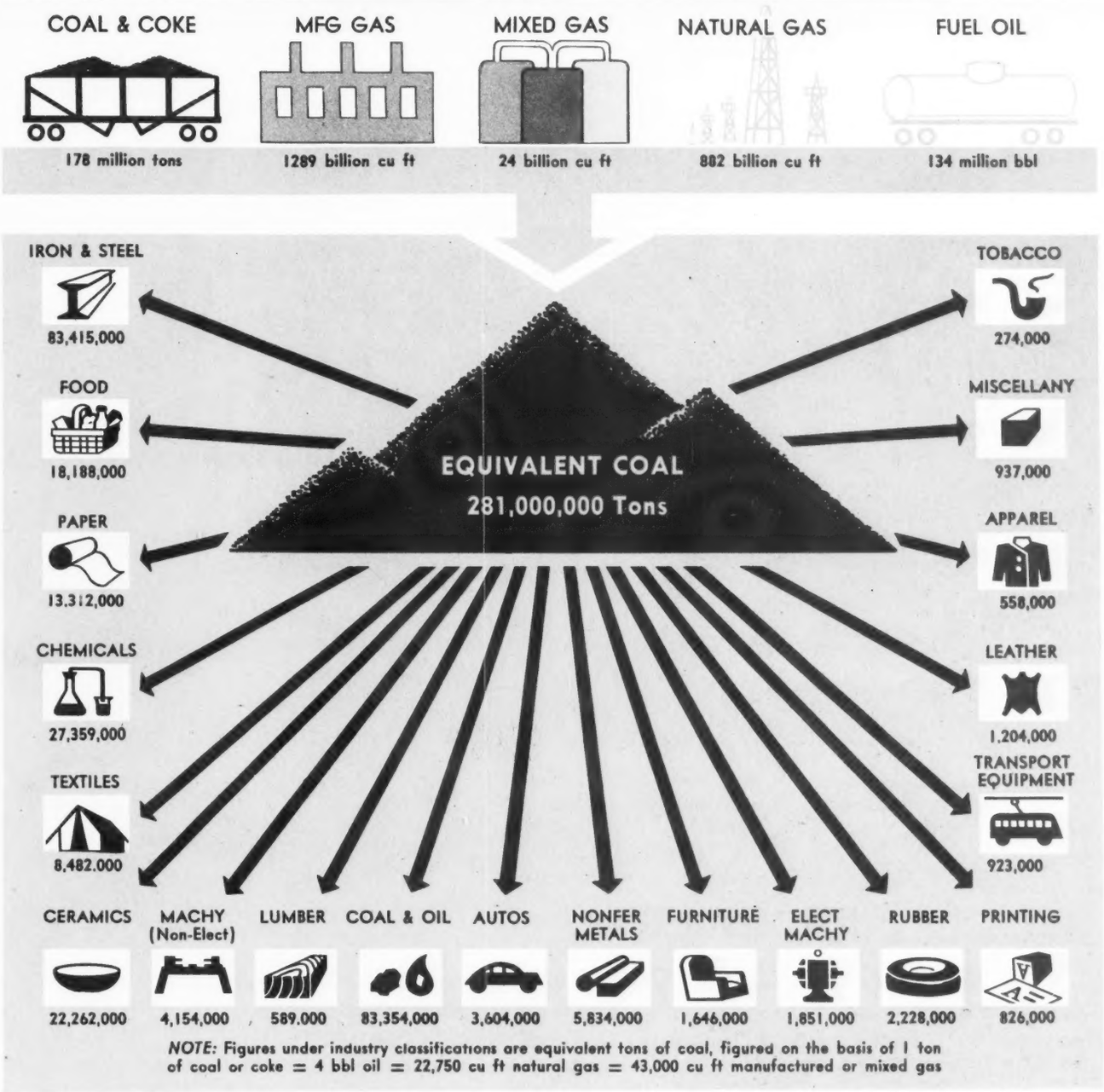
Whatever the industry, none can operate without fuel. No question about the supply—but availability is another matter. Normal consumption of power and fuel has been scrambled by the demands of defense (see section on fuel resources), but any planning must consider a return to the peace-time picture outlined here.

Consumption of Fuel by Industry — 1939

Industry Group	Bituminous Coal, Tons	Anthracite, Tons	Coke, Tons	Fuel Oil, Barrels	Natural Gas, 1000 Cu Ft	Mfg Gas, 1000 Cu Ft	Mixed Gas, 1000 Cu Ft	Equivalent Coal, Tons
All industries—total	**137,771,432**	**5,015,857**	**35,115,357**	**133,773,524**	**881,830,178**	**1,288,727,385**	**24,536,692**	**281,000,000**
Food and kindred products	10,569,956	738,331	288,266	11,324,669	79,132,619	10,156,723	2,107,341	18,188,000
Tobacco manufactures	243,044	16,958	2,807	36,163	15,780	20,466	5,351	274,000
Textile-mill products	5,520,335	507,225	10,885	9,252,369	2,718,782	589,132	23,110	8,482,000
Apparel and other finished products	314,438	46,427	2,620	436,580	1,383,370	954,386	127,568	558,000
Lumber and timber basic products	384,547	13,402	602	713,577	231,873	8,700	3,569	589,000
Furniture and finished lumber products	1,406,992	49,289	9,491	308,002	2,201,437	229,853	68,041	1,646,000
Paper and allied products	9,195,092	1,039,053	23,594	6,696,005	29,517,668	219,503	175,267	13,312,000
Printing, publishing and allied industries	412,703	64,668	2,623	602,782	2,189,205	3,250,075	1,041,836	826,000
Chemicals and allied products	9,658,592	641,495	438,718	11,492,567	304,958,406	13,688,560	1,455,204	27,359,000
Products of petroleum and coal	63,766,747	43,735	87,141	38,260,911	118,574,027	201,423,993	6,897,146	83,354,000
Rubber products	1,847,679	23,169	686	670,605	3,732,453	1,035,782	57,893	2,228,000
Leather and leather products	999,183	66,768	226	394,345	859,409	83,311	19,872	1,204,000
Stone, clay and glass products	12,223,144	239,112	136,706	8,112,571	148,074,702	4,254,393	690,655	22,262,000
Iron and steel products (except machinery)	12,262,017	510,949	33,182,227	33,055,145	122,465,718	1,031,991,882	8,241,041	83,415,000
Nonferrous metals and their products	1,789,626	598,356	420,151	4,549,520	36,582,992	11,125,109	839,285	5,834,000
Electrical machinery	1,181,882	123,626	13,458	1,283,928	3,350,025	2,433,215	330,188	1,851,000
Machinery (except electrical)	2,443,017	138,988	298,975	2,992,645	9,943,553	3,675,812	1,470,230	4,154,000
Automobiles and automobile equipment	2,561,255	13,196	149,822	1,621,116	9,415,003	2,099,581	547,959	3,604,000
Transportation equipment (except auto)	497,064	53,249	40,856	1,059,316	1,070,796	400,481	16,784	923,000
Miscellaneous industries	494,119	87,861	5,503	710,708	5,412,360	1,086,448	418,352	937,000

Note: All tons are 2000 lb 4 bbl oil = 22,750 cu ft natural gas = 43,000 cu ft mfg or mixed gas = 1 ton coal

WHERE INDUSTRY'S FUEL GOES



NOTE: Figures under industry classifications are equivalent tons of coal, figured on the basis of 1 ton of coal or coke = 4 bbl oil = 22,750 cu ft natural gas = 43,000 cu ft manufactured or mixed gas

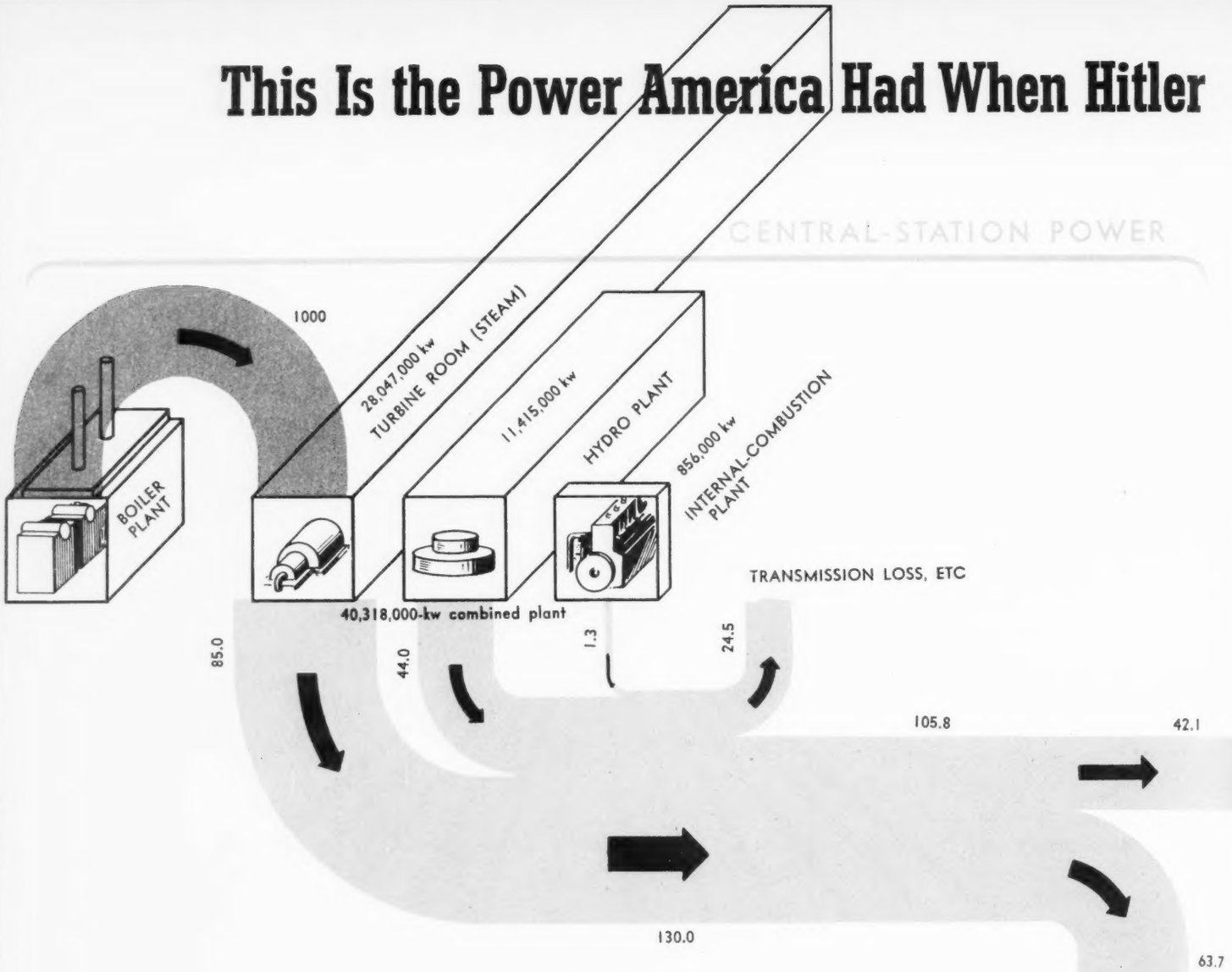
Within the next twelve months, there must be huge expansion in some industries, curtailment in others. The former requires time, precious and ill-spared now. The power engineer, in a position to aid defense production immeasurably, can help by using local public supply, still adequate in most parts of the country. Power can be brought in a lot quicker from utility lines, if they can carry the added load, than boilers and turbines can be built, installed, and a complete extension put on the line.

Prime Movers, Motors and Generators in Manufacturing Plants

Year	Aggregate Horsepower	Prime Movers, Horsepower	Electric Motors Driven by Purchased Energy		Electric Motors Driven by Plant Energy		Electric Generators, Kilowatts
			Number	Horsepower	Number	Horsepower	
1899....	9,960,980	9,778,418	.....	182,562	16,891	310,374	.....
1904....	13,296,394	12,854,805	.....	441,589	73,119	1,150,886	.....
1909....	18,551,737	16,802,706	199,309	1,749,031	189,545	3,068,109	.....
1914....	22,290,899	18,406,175	447,502	3,884,724	321,323	4,938,530	.....
1919....	29,327,669	20,043,170	976,463	9,284,499	486,874	6,969,203	.....
1923....	33,094,228	19,728,565	1,445,003	13,365,663	616,422	8,821,551	.....
1925....	35,772,628	19,903,800	1,724,180	15,868,828	772,445	10,254,745	6,887,045
1927....	38,825,681	19,693,371	2,151,675	19,132,310	790,810	11,219,979	7,345,685
1929....	42,931,061	20,155,397	2,724,843	22,775,664	852,432	12,376,376	7,793,875
1939....	51,154,523	21,266,557	4,138,169	29,887,966	1,224,637	16,078,658	9,674,934

Note: Figures for 1919 and earlier years are not strictly comparable with later years because of change from $500 limit to $5000 in minimum value of products.

This Is the Power America Had When Hitler



U.S.A. HOOKUP

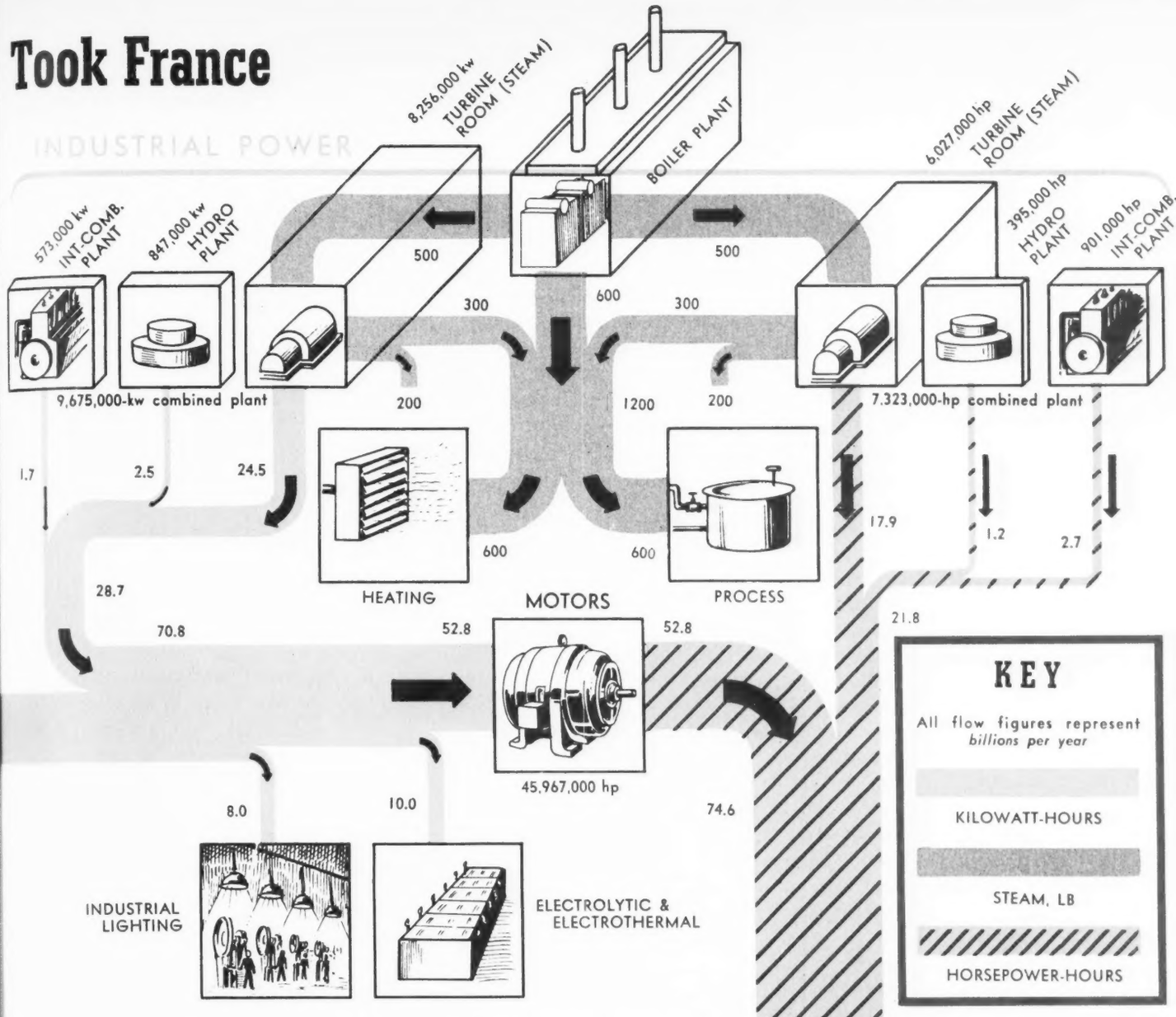
This power-and-energy flow chart of America is based on data for 1939, latest for which full census figures are available. The plant above represents the entire central-station capacity of the United States (utility, federal and municipal). Prime movers are grouped in separate subplants – steam, hydro and internal combustion. The boiler plant, too, is shown separately to permit better comparison with industry's steam-generating capacity.

This imaginary giant central station generated (in 1939) 130 billion kwhr, of which 63.7 billion were delivered to non-manufacturing uses and 42.1 billion were sold to manufacturing establishments. To this purchased energy industry added 28.7 billion kwhr generated in its own electrical plant to make a total of 70.8 billion kwhr.

Industry's composite power house is shown in three parts: left, electrical generation; right, production of mechanical horsepower; center, generation of steam for all uses. Both kilowatt and horsepower plants are divided into subplants – steam, hydro and internal combustion.

The boiler plant, dominating the industrial-power picture, turned out 1600 billion lb of steam for 24.5 billion kwhr plus 17.9 billion hphr. In contrast, the central-station boiler room generated only 1000 billion lb of steam for 85.0 billion steam-generated kwhr. The chart shows the reason – industry's process and heating steam. *Any picture of industrial power that neglects process and heating steam is meaningless.*

Took France



KEY

All flow figures represent *billions per year*

KILOWATT-HOURS

STEAM, LB

HORSEPOWER-HOURS

SOURCES AND NOTES

Central-station capacity, output and distribution—FPC.

Central-station steam output—Factor of 8.5 lb steam per lb coal applied to 59.5 million tons equivalent coal consumption (from FPC).

Generating capacity, energy output and purchase of industrial plants; also motor capacity—U. S. Census.

Output of industrial steam, hydro and internal-combustion plants — Prorated, assuming same use factor for all units.

Electrolytic and electrothermal energy consumption—From FPC report for 1936 boosted to take care of estimated increase to 1939.

Industrial steam — Considering only coal, oil and natural gas (U. S. Census) and deducting estimated non-steam fuel, equivalent steam coal for manufacturing is about 100,000,000 tons producing about 1600 billion lb steam, distributed (by rough approximation) as shown.

*Includes stores, mines, quarries, institutions, public buildings, hotels.

**Street lighting and other public authority.

***Horsepower-band widths purely arbitrary and illustrative.

Central Stations Bear the Brunt of the Load

INDUSTRY'S PURCHASE of kwhr, measured approximately by sales to large customers, is currently running 30% above last year. Central stations, with 83% of the nation's public power-generating capacity, is supplying this load without interrupting normal civilian use except in the southeastern section of the country where prolonged drought, only partly relieved by recent rainfall, has created an actual shortage of kwhr.

All other geographical areas now have adequate generating equipment supported by ample reserves for any loads that can be definitely foreseen. Utilities now have, for instance, more actual margin between demand and name-plate rating than their entire installed capacity at the outbreak of the first world war—some 8 to 9 million kw.

Most of the central-station engineers and operators received their training during periods of rapid expansion. They learned the lesson of "safe" reserve, not only for equipment outage but also for under—and sometimes over—estimation of the peak load for two years ahead. This practical knowledge grew from experience in handling boilers that required regular replacement of brickwork, turbines that suffered a variety of temperamental metallurgical maladies, and relatively complex auxiliaries that, driven out of service by obscure causes, could rob a plant of useful kilowatts.

Much of the generating capacity of 1941 is relatively new. Boilers, once a continual headache, have now established records of practically continuous operation when needed. Older plants have been modernized, lived with and patched until they too have become more dependable because their problems are better known. Even without an emergency, future planning would consider a smaller percentage of actual reserve than fixed by the policy of the 1920's.

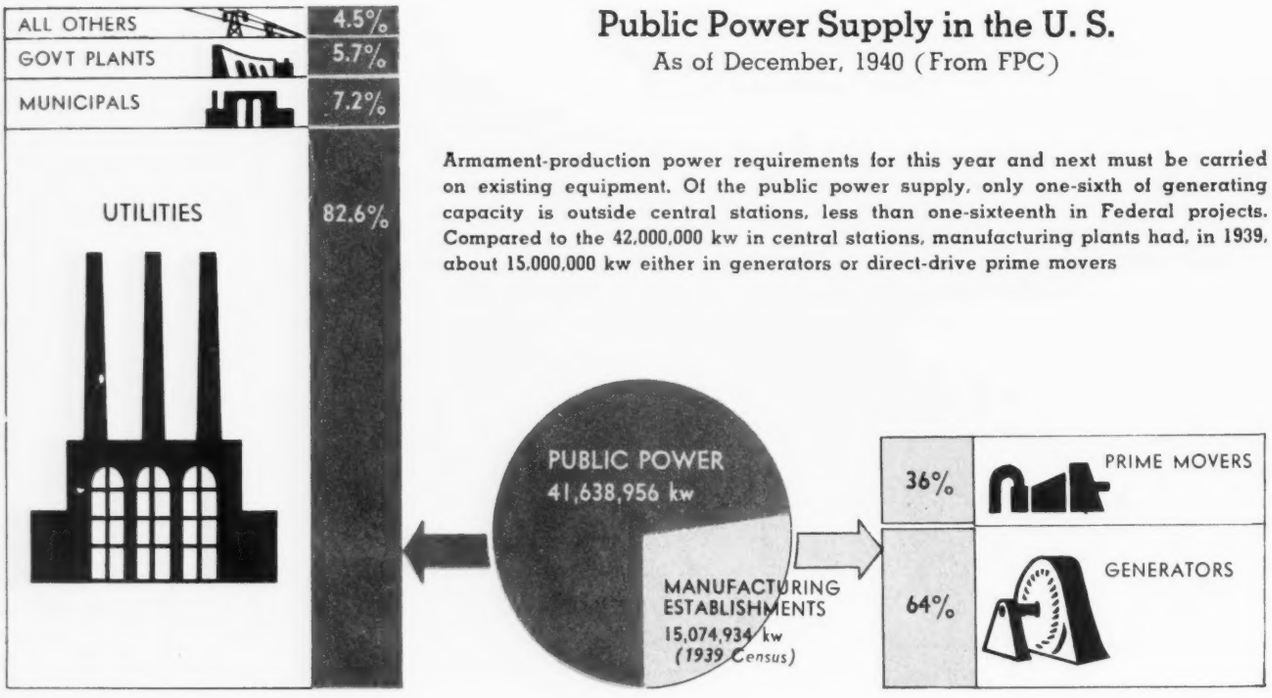
This year, loads are taxing central stations more than would have been the case if armament expansion and a full-fledged industrial boom had not blossomed together. No one wants to face a situation where his reputation is damaged by a major plant failure,

Public power-generating capacity in 1940 exceeded peak loads by more than the entire installed capacity in 1914. About 6,000,000 kw were added during the first world-war period (1914-20), nearly 7,000,000 are now on order for the next two years, and another 13,000,000 kw are projected through 1946. Steam turbines still carry the lion's share of the power job; new steam units total twice the capacity of hydro projects

Public Power Supply in the U. S.

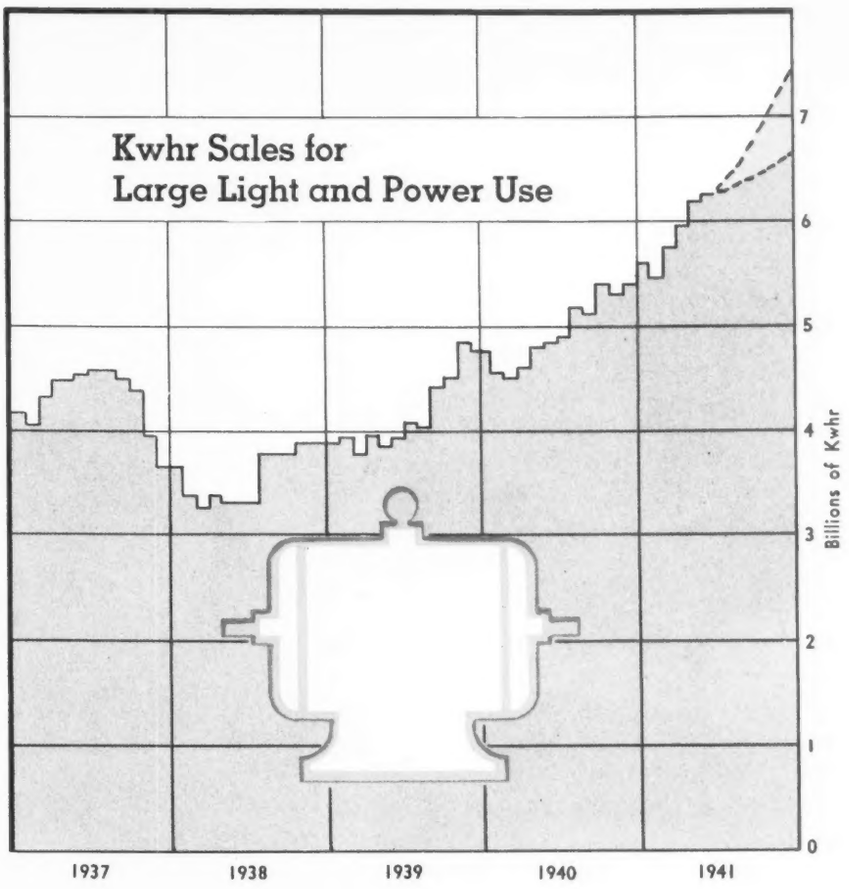
As of December, 1940 (From FPC)

Armament-production power requirements for this year and next must be carried on existing equipment. Of the public power supply, only one-sixth of generating capacity is outside central stations, less than one-sixteenth in Federal projects. Compared to the 42,000,000 kw in central stations, manufacturing plants had, in 1939, about 15,000,000 kw either in generators or direct-drive prime movers



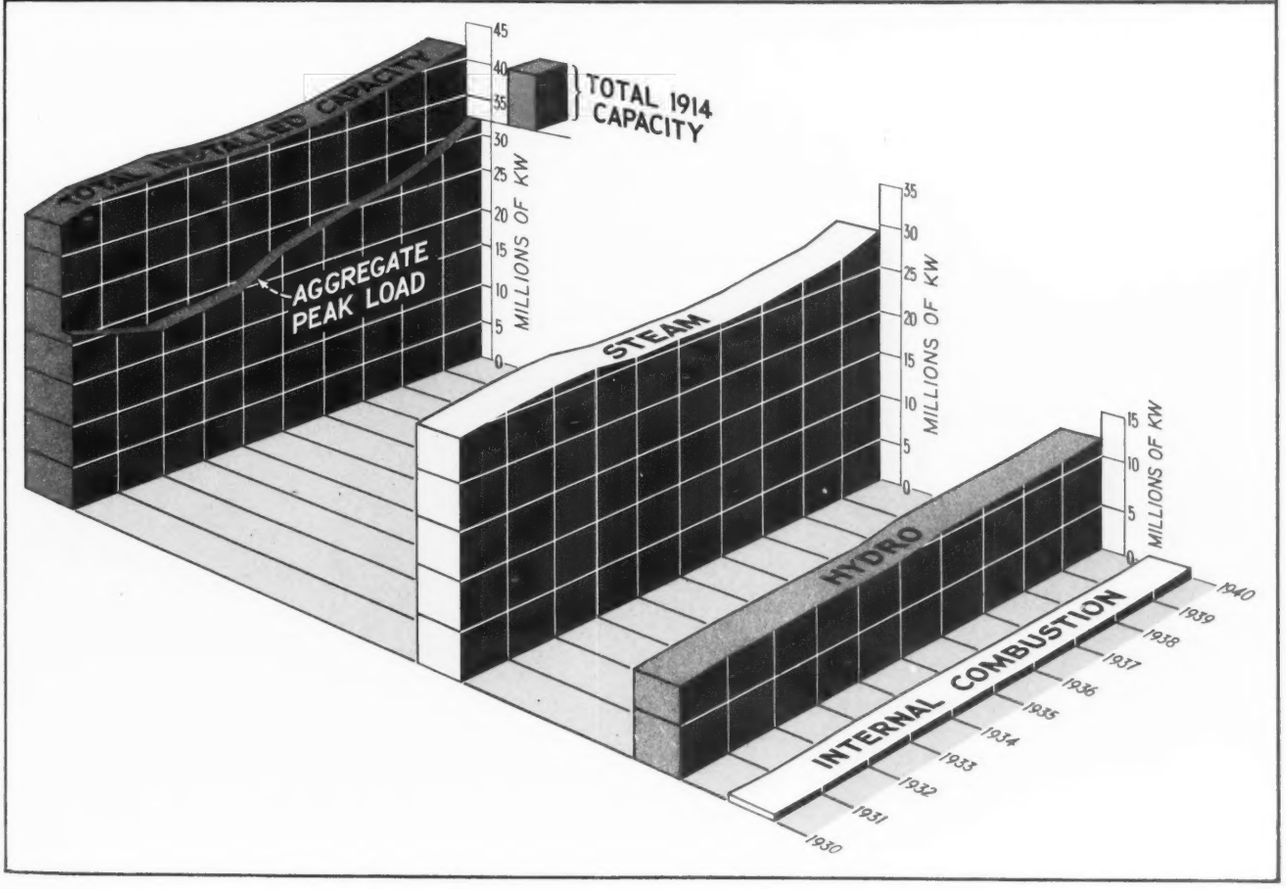
but the men who have to answer for the safety of their equipment, their livelihood and their professional integrity say they can meet 1941 loads. They say they can do so without taking a dangerous bite into "reserve" capacity. They believe they can take on, certainly this year and without much question next year, new power loads without rationing residential and commercial customers.

To say that emergencies will be met without some measure of risk, or without some local and some more or less temporary readjustments, is to underestimate the problem ahead. However, this fact is on record: private utilities are today better prepared to meet emergencies than at any time in their history.

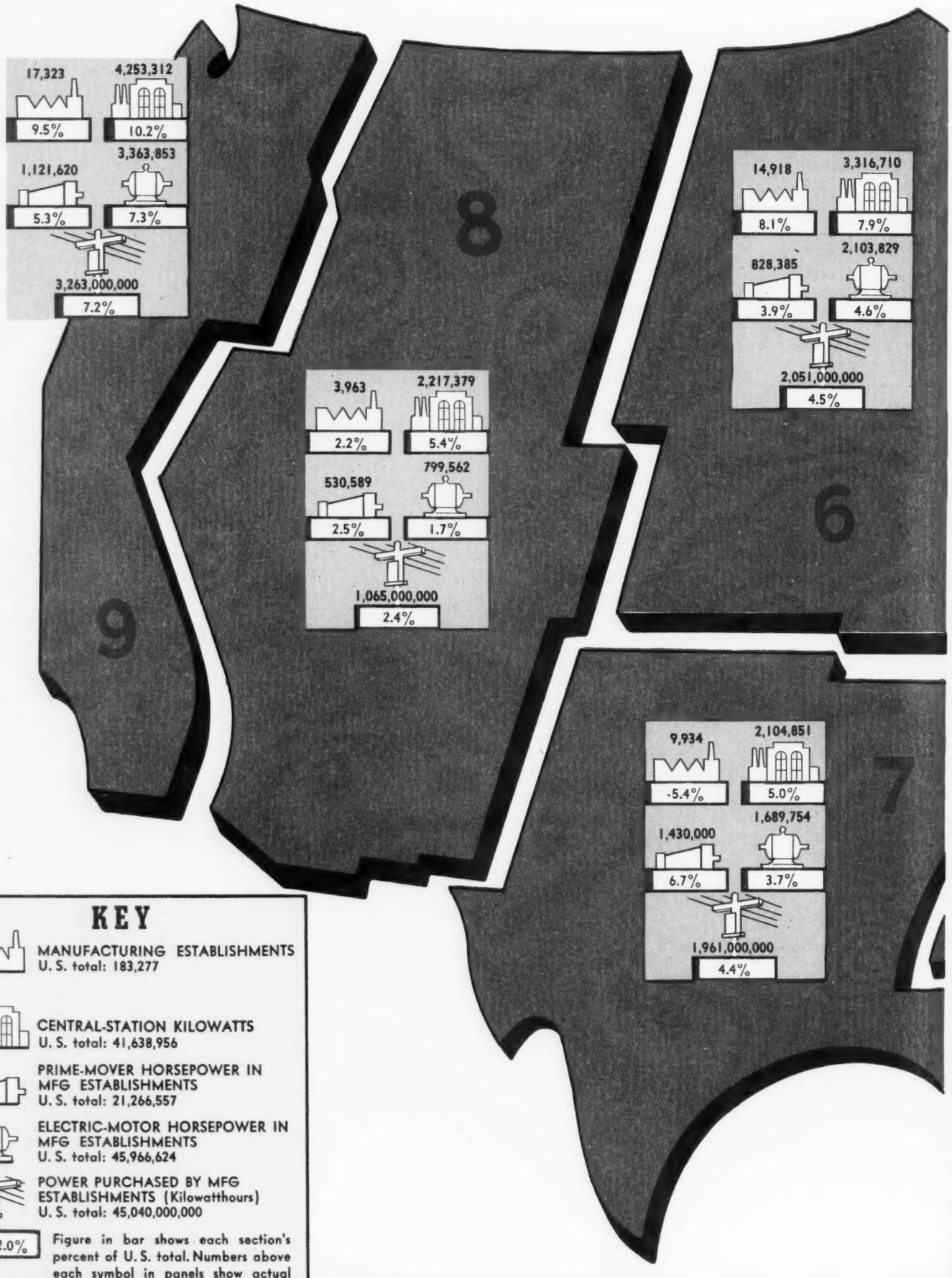


Monthly sales of light and power are a barometer of industrial production. The large customers of public utilities are currently using 30% more power than for corresponding months last year

Installed Generating Capacity and Peak Load of Public-Supply Plants



Capacity to Produce Arms Depends on Distribution



KEY

MANUFACTURING ESTABLISHMENTS
U. S. total: 183,277

CENTRAL-STATION KILOWATTS
U. S. total: 41,638,956

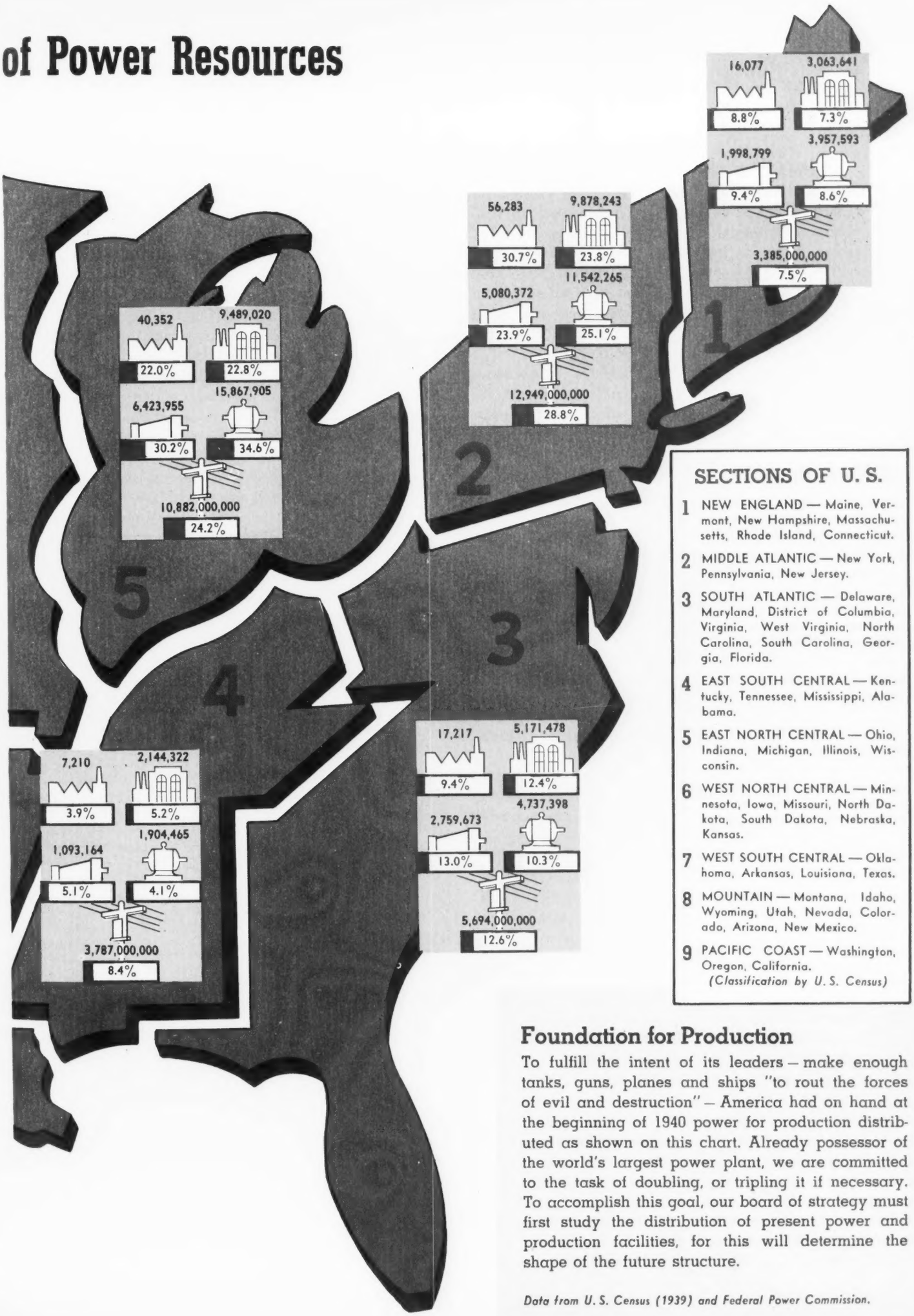
PRIME-MOVER HORSEPOWER IN MFG ESTABLISHMENTS
U. S. total: 21,266,557

ELECTRIC-MOTOR HORSEPOWER IN MFG ESTABLISHMENTS
U. S. total: 45,966,624

POWER PURCHASED BY MFG ESTABLISHMENTS (Kilowatthours)
U. S. total: 45,040,000,000

22.0% Figure in bar shows each section's percent of U. S. total. Numbers above each symbol in panels show actual quantities.

# of Power Resources



SECTIONS OF U. S.

1 NEW ENGLAND — Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut.

2 MIDDLE ATLANTIC — New York, Pennsylvania, New Jersey.

3 SOUTH ATLANTIC — Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida.

4 EAST SOUTH CENTRAL — Kentucky, Tennessee, Mississippi, Alabama.

5 EAST NORTH CENTRAL — Ohio, Indiana, Michigan, Illinois, Wisconsin.

6 WEST NORTH CENTRAL — Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas.

7 WEST SOUTH CENTRAL — Oklahoma, Arkansas, Louisiana, Texas.

8 MOUNTAIN — Montana, Idaho, Wyoming, Utah, Nevada, Colorado, Arizona, New Mexico.

9 PACIFIC COAST — Washington, Oregon, California.

(Classification by U. S. Census)

Foundation for Production

To fulfill the intent of its leaders – make enough tanks, guns, planes and ships "to rout the forces of evil and destruction" – America had on hand at the beginning of 1940 power for production distributed as shown on this chart. Already possessor of the world's largest power plant, we are committed to the task of doubling, or tripling it if necessary. To accomplish this goal, our board of strategy must first study the distribution of present power and production facilities, for this will determine the shape of the future structure.

Data from U. S. Census (1939) and Federal Power Commission.

New Kilowatts Outrace Power Shortage

AN ARMAMENT PROGRAM that has been boosted from 5 billion dollars per year to the astounding projected figure of 50 billion has forced all concerned with design, construction and operation of power plants to look further into the future than ever before. Moreover, today's "forced-draft" conditions mean priorities, turbine and boiler orders far in advance of actual installation schedules, and close cooperation between planners of public power supply and producers of defense equipment.

A leading factor in this situation is the unprecedented demand for materials such as aluminum, copper, magnesium, etc, all of which require large amounts of electric energy for their production. With the goal for aluminum set at twice the present yearly production of 800 million lb per year, for example, and with manufacture of other defense necessities scheduled for twofold and threefold expansion, the Administration has laid down a program of power expansion far exceeding previous private estimates.

IT IS NOT NOW TIME to question motives, economics or the fate of private enterprise "after the war", although no one can avoid a certain amount of speculation as to what the nation will do with its huge power system after the emergency. The immediate need is to build armament in the quantity and of the quality demanded by the Army and Navy, which means that electrical-generating plants must be planned to suit this need.

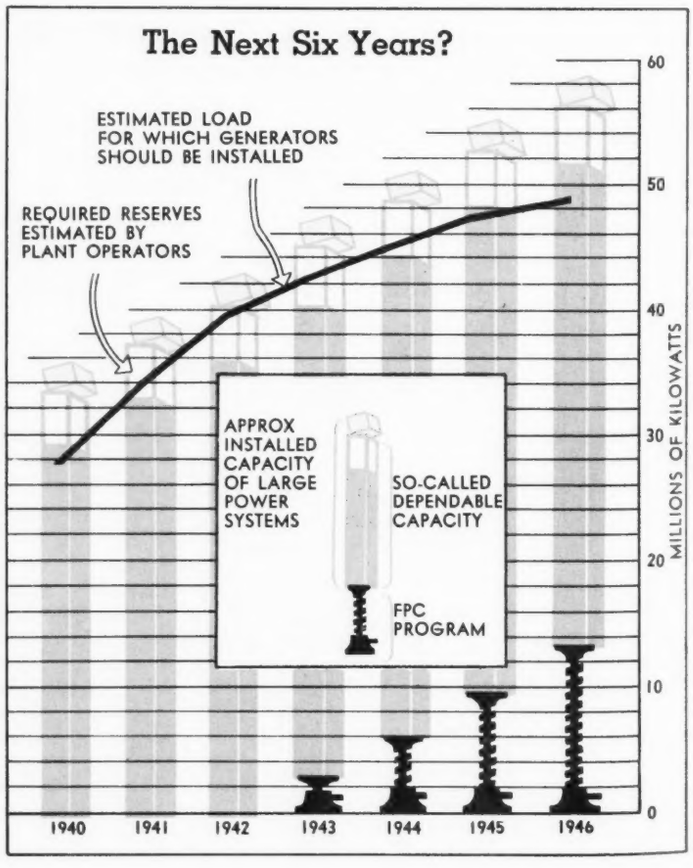
On the facing page is tabulated a nearly complete list of steam turbines now on order (shown in black) and a long-range program (in orange) proposed by the Federal Power Commission, which includes hydroelectric units listed on page 107. This program needs no load curve as a guide; it is an expression of the thesis that we must plan to build as fast as we can. The schedule can be slowed down at any time by the stroke of a pen; it is extremely difficult to speed up.

ACTUAL ORDERS now fill turbine manufacturers' shops to the limit of their capacity; continuance at approximately the maximum rate of 2½ million kw of steam and about 1 million kw of hydro per year with existing and projected turbine-production facilities is the most we can hope for.

UTILITIES ARE FACED with the problem of carrying 1941 and 1942 peaks with turbine-generators now in operation and under construction. Plans not already made can give no help during the immediate critical period ahead.

Central-station engineers have faced this same problem in good times and bad for many years past. They have learned the value of time as an important element in their construction program. They state unanimously that power peaks of this year and next can be met without serious curtailment of civilian use.

Load estimates vary widely, as is to be expected in times of rapid growth. Even with kwhr sales to industry running 30% above last year's corresponding months, utilities find it difficult to expect that the December 1941 peak will total 6 million kw above 1940, as "planned for" by the Federal Power Commission forecast shown in the chart below. Even so, and even if load growth in 1942 should result in 5½ more millions of kilowatts demand, the national picture is not one of critical power shortage.



THE NEXT SIX YEARS call for addition of over 13,000,000 kw of new capacity for utility, municipal and government plants, according to the Federal Power Commission program charted here. The FPC's estimate of load growth forecasts tight years for 1942 and 1943, since demand is expected to eat deeply into reserves

13,400,000 New Steam Kilowatts Will Back Up U. S. Production Lines

Here are all new central-station steam units going in. Turbines on order are shown in black; units proposed by the Federal Power Commission are listed in orange

13,400,000 New Steam Kilowatts Will Back Up U. S. Production Lines

Here are all new central-station steam units going in. Turbines on order are shown in black; units proposed by the Federal Power Commission are listed in orange

System	Station	State	1941	1942	1943	1944	1945	1946	Total
REGION I									
Central Maine Power Co	Wiscasset	Maine	.....	.....	.....	.....	40,000	.....	40,000
N. H. Gas & Electric Co	Portsmouth	N. H.	.....	.....	40,000	.....	.....	.....	40,000
Montaup Electric Co	Somerset	Mass.	20,000	.....	.....	.....	.....	.....	20,000
Boston Edison Co	Mystic	Mass.	.....	50,000	40,000	40,000	40,000	.....	290,000
Boston Edison Co	L Street	Mass.	.....	18,750	.....	.....	.....	.....	18,750
Boston Edison Co	Edgar	Mass.	.....	.....	.....	.....	80,000	.....	80,000
New Bedford Gas & Elec Lt	Canon Street	Mass.	.....	7,500	.....	.....	.....	.....	7,500
Narragansett Electric Co	Manchester St	R. I.	40,000	.....	.....	.....	40,000	.....	80,000
United Illuminating Co	English	Conn.	.....	.....	.....	80,000	.....	.....	80,000
United Illuminating Co	Steel Point	Conn.	25,000	.....	25,000	.....	.....	.....	50,000
Hartford Electric Co	South Meadow	Conn.	.....	45,000	.....	.....	.....	80,000	125,000
Connecticut Lt & Pr Co	Montville	Conn.	.....	.....	.....	.....	40,000	.....	40,000
Connecticut Lt & Pr Co	Devon	Conn.	.....	45,000	.....	.....	.....	.....	45,000
Connecticut Power Co	Stamford	Conn.	25,000	.....	.....	.....	80,000	.....	105,000
L. I. Lighting Co	Glenwood	N. Y.	.....	.....	.....	.....	.....	.....	80,000
Central N. Y. Pwr Corp	Oswego	N. Y.	80,000	.....	.....	.....	.....	80,000	240,000
Central N. Y. Pwr Corp	Dunkirk	N. Y.	.....	.....	.....	.....	.....	240,000	240,000
Buffalo-Niagara Pwr Corp	Huntley	N. Y.	.....	80,000	.....	.....	.....	80,000	160,000
Central Hudson G & E Co	Riverside	N. Y.	.....	.....	.....	.....	40,000	80,000	120,000
N. Y. State E & G Co	Binghamton	N. Y.	.....	.....	.....	.....	.....	40,000	40,000
N. Y. State E & G Co	Riverside	N. Y.	.....	.....	.....	.....	.....	40,000	40,000
N. Y. State E & G Co	Greenidge	N. Y.	.....	20,000	.....	.....	.....	40,000	60,000
New York Pwr & Lt Co	Schenectady	N. Y.	.....	.....	.....	.....	.....	80,000	80,000
Consolidated Edison Co	Sherman Creek	N. Y.	.....	50,000	.....	.....	.....	.....	50,000
Consolidated Edison Co	Waterside	N. Y.	65,000	.....	.....	.....	.....	.....	65,000
Rochester G & E Co	No. 3	N. Y.	15,000	25,000	.....	.....	.....	.....	40,000
Penna Pwr & Lt Co	Stanton	Pa.	.....	.....	.....	.....	.....	80,000	80,000
Penna Pwr & Lt Co	Sunbury	Pa.	.....	.....	.....	.....	.....	160,000	160,000
Metropolitan Edison Co	Middletown	Pa.	.....	.....	.....	.....	.....	80,000	80,000
Metropolitan Edison Co	West Reading	Pa.	20,000	.....	55,000	.....	.....	.....	75,000
Philadelphia Electric Co	Southwark	Pa.	.....	.....	300,000	.....	.....	.....	300,000
Philadelphia Electric Co	Chester	Pa.	50,000	80,000	.....	.....	.....	.....	130,000
Penna. Power & Light Co	Cedar Street	Pa.	15,000	.....	.....	.....	.....	.....	15,000
Penna. Electric Co	Seward	Pa.	35,000	.....	.....	.....	.....	.....	35,000
Jersey Cent Pwr & Lt Co	Raritan River	N. J.	.....	.....	25,000	.....	.....	.....	25,000
Atlantic City Electric Co	Atlantic City	N. J.	25,000	.....	.....	.....	.....	.....	25,000
Deepwater Operating Co	Deepwater	N. J.	.....	20,000	.....	.....	.....	.....	20,000
Public Serv Elec & Gas Co	Burlington	N. J.	.....	100,000	.....	.....	.....	.....	200,000
Public Serv Elec & Gas Co	Marion	N. J.	50,000	50,000	.....	.....	.....	.....	100,000
New Jersey Pwr & Lt Co	Gilbert	N. J.	.....	.....	.....	.....	.....	80,000	80,000
Cons Gas Elec & Pwr Co	Riverside	Md.	.....	50,000	.....	80,000	80,000	.....	210,000
Cons Gas Elec Lt & Pwr Co	Westport	Md.	50,000	.....	.....	.....	.....	.....	50,000
Delmarva Power Co	Vienna	Md.	7,500	.....	.....	.....	.....	.....	7,500
Potomac Electric Co	Blue Plains	D. C.	.....	.....	.....	80,000	80,000	80,000	240,000
Potomac Electric Co	Buzzard Point	D. C.	50,000	50,000	.....	.....	.....	.....	100,000
REGION II									
West Penn Power Co	Springdale	Pa.	.....	.....	40,000	.....	40,000	.....	120,000
West Penn Power Co	Windsor	W. Va.	60,000	.....	.....	.....	.....	.....	60,000
Duquesne Light Co	F R Phillips	Pa.	.....	60,000	60,000	60,000	.....	.....	180,000
Duquesne Light Co	James H Reed	Pa	60,000	.....	.....	.....	.....	.....	60,000
Pennsylvania Edison Co	Raystown	Pa.	.....	.....	.....	40,000	.....	.....	40,000
Northern Va. Power Co	Millville	W. Va.	.....	.....	.....	40,000	.....	.....	40,000
Monongahela—W P P S Co	Parkersburg	W. Va.	.....	.....	.....	40,000	40,000	40,000	180,000
Monongahela—W P P S Co	Rivesville	W. Va.	.....	35,000	.....	.....	.....	.....	35,000
Appalachian Elec Pwr Co	Cabin Creek	W. Va.	.....	170,000	.....	.....	.....	.....	170,000
Appalachian Elec Pwr Co	Glen Lyn	Va.	.....	.....	.....	80,000	.....	.....	170,000
Cleveland Elec Ill. Co	Avon	Ohio	.....	.....	50,000	.....	100,000	.....	150,000
Cleveland Elec Ill. Co	Lake Shore	Ohio	60,000	60,000	60,000	60,000	60,000	.....	300,000
City of Cleveland	Cleveland	Ohio	.....	.....	.....	.....	.....	25,000	25,000
Cincinnati Gas & Elec Co	Columbia	Ohio	.....	65,000	.....	120,000	120,000	.....	305,000
Ohio Edison Co	Gorge	Ohio	.....	35,000	.....	.....	.....	.....	35,000
Columbus & S Ohio E Co	Picway	Ohio	.....	30,000	.....	.....	.....	60,000	90,000
Toledo Edison Co	Acme	Ohio	50,000	.....	.....	50,000	.....	.....	100,000
Toledo Edison Co	Water Street	Ohio	.....	.....	.....	.....	50,000	.....	50,000
Ohio Public Serv Co	Edgewater	Ohio	.....	.....	.....	35,000	35,000	.....	70,000
Marion Reserve Pwr Co	Scioto	Ohio	12,500	.....	.....	.....	.....	.....	12,500
Ohio Power Co	Philo	Ohio	85,000	85,000	.....	85,000	.....	.....	255,000
Consumers Power Co	Morrow	Mich.	50,000	.....	.....	.....	50,000	.....	100,000
Consumers Power Co	Weadock	Mich.	35,000	50,000	.....	50,000	50,000	.....	185,000
Detroit Edison Co	Conners Creek	Mich.	.....	.....	.....	.....	.....	150,000	150,000
Detroit Edison Co	Delray	Mich.	75,000	.....	.....	.....	.....	.....	75,000
Detroit Edison Co	Marysville	Mich.	.....	75,000	.....	.....	.....	.....	150,000
Detroit Edison Co	Trent. Channel	Mich.	.....	.....	.....	.....	.....	150,000	150,000
Southern Ind. Gas & E Co	Ohio River	Ind.	.....	20,000	.....	.....	.....	40,000	60,000
Indianapolis Pwr & Lt Co	Harding St	Ind.	37,500	.....	37,500	.....	.....	60,000	135,000
Pub Serv Co of Indiana	Dresser	Ind.	50,000	.....	.....	.....	.....	60,000	110,000
Louisville Gas & Elec Co	Waterside	Ky.	.....	.....	.....	.....	.....	60,000	60,000
Louisville Gas & Elec Co	Canal	Ky.	25,000	.....	.....	.....	.....	.....	25,000
Louisville Gas & Elec Co	Paddy's Run	Ky.	.....	50,000	.....	.....	.....	.....	50,000
Kentucky Utilities Co	Tyrone	Ky.	.....	.....	.....	.....	.....	25,000	25,000
REGION III									
Virginia Pub Serv Co	Alexandria	Va.	.....	15,000	.....	.....	.....	.....	15,000
Virginia Pub Serv Co	Bremo	Va.	.....	.....	.....	.....	.....	80,000	80,000
Virginia Elec & Pwr Co	Reeves Ave	Va.	40,000	.....	.....	.....	.....	.....	40,000
Virginia Elec & Pwr Co	Petersburg	Va.	.....	.....	40,000	.....	.....	40,000	80,000
Duke Power Co	Cliffside	N. C.	.....	.....	40,000	.....	.....	.....	40,000
Duke Power Co	River Bend	N. C.	.....	.....	40,000	.....	.....	.....	40,000
Duke Power Co	Buck	N. C.	80,000	40,000	.....	.....	.....	.....	200,000
Duke Power Co	Tiger	S. C.	.....	.....	40,000	.....	.....	.....	40,000
Carolina Pwr & Lt Co	Cape Fear	N. C.	.....	60,000	50,000	50,000	.....	.....	110,000
Carolina Pwr & Lt Co	Raleigh	N. C.	.....	.....	.....	.....	.....	50,000	50,000
South Carolina Pwr Co	Parr	S. C.	.....	.....	.....	.....	80,000	.....	120,000
South Carolina Pwr Co	Charleston	S. C.	.....	.....	.....	.....	25,000	.....	25,000
Georgia Power Co	Arkwright	Ga.	40,000	40,000	.....	.....	40,000	.....	160,000
Georgia Power Co	Columbus	Ga.	.....	.....	.....	60,000	.....	.....	60,000
Georgia Power Co	Atkinson	Ga.	60,000	.....	.....	.....	.....	.....	60,000
Savannah Elec & Pwr Co	Riverside	Ga.	.....	.....	.....	.....	25,000	.....	25,000
Tampa Electric Co	West Jackson	Fla.	.....	15,000	.....	.....	.....	.....	15,000
Florida Pwr & Lt Co	Lauderdale	Fla.	.....	.....	.....	.....	.....	25,000	25,000
Florida Power Corp	River Junction	Fla.	.....	.....	.....	.....	.....	40,000	40,000
Alabama Power Co	Gorgas No. 2	Ala.	.....	.....	.....	.....	.....	120,000	120,000
Alabama Power Co	Chickasaw	Ala.	40,000	40,000	.....	.....	.....	160,000	160,000
Alabama Power Co	Montgomery	Ala.	.....	.....	.....	.....	.....	40,000	40,000
Tenn. Valley Auth	Watts Bar	Tenn.	60,000	120,000	.....	.....	.....	.....	180,000
REGION IV									
Wis.-Mich. Power Co	Bayside	Wis.	.....	30,000	.....	.....	.....	80,000	80,000
Wis. Electric Pwr Co	Commerce St	Wis.	35,000	.....	.....	.....	.....	100,000	135,000
Wis. Electric Pwr Co	Pt Washington	Wis.	.....	80,000	.....	.....	80,000	80,000	240,000
Wis. Power & Light Co	Edgewater	Wis.	30,000	.....	.....	.....	.....	.....	30,000
Superior Water Lt & Pwr	Winslow	Wis.	.....	12,500	.....	.....	.....	.....	12,500
Commonwealth Edison Co	Crawford Ave	Ill.	.....	.....	.....	.....	80,000	80,000	160,000
Commonwealth Edison Co	Powerton	Ill.	.....	.....	.....	.....	150,000	.....	150,000
Commonwealth Edison Co	Northwest	Ill.	.....	.....	.....	.....	.....	80,000	80,000
Commonwealth Edison Co	Fisk	Ill.	147,000	.....	150,000	.....	.....	.....	297,000
Chicago Dist Elec Gen Co	State Line	Ind.	.....	.....	.....	150,000	.....	.....	150,000
Central Ill. Light Co	East Peoria	Ill.	35,000	.....	.....	.....	.....	.....	35,000
Central Ill. Pub Serv Co	Grand Tower	Ill.	.....	.....	.....	.....	40,000	.....	40,000
Central Ill. Pub Serv Co	Hutsonville	Ill.	25,000	25,000	.....	.....	.....	.....	50,000
Central Ill. Pub Serv Co	Meredosia	Ill.	.....	.....	.....	.....	.....	20,000	20,000
P S Co of North. Ill	Joliet	Ill.	25,000	.....	.....	.....	.....	.....	25,000
Moline-Rock Is. Mfg Co	Moline	Ill.	17,140	.....	.....	.....	80,000	80,000	117,140
Union Electric Co of Mo.	Venice	Ill.	40,000	.....	.....	80,000	.....	.....	120,000
Union Electric Co of Mo.	Ashley St	Mo.	.....	.....	.....	.....	80,000	80,000	160,000
Northern Ind. P S Co	E. Chicago	Ind.	.....	.....	.....	60,000	.....	.....	60,000
Northern Ind. P S Co	Michigan City	Ind.	.....	.....	.....	.....	80,000	80,000	160,000
Moline-Rock Is. Mfg Co	Riverside	Iowa	.....	.....	.....	.....	.....	50,000	50,000
Interstate Power Co	Albert Lea	Minn.	7,500	.....	.....	.....	.....	.....	7,500
Interstate Power Co	Dubuque	Iowa	.....	.....	.....	.....	20,000	.....	20,000
Northern States Pwr Co	High Bridge	Minn.	50,000	.....	.....	.....	.....	.....	100,000
Minn. Power & Light Co	Duluth	Minn.	.....	.....	.....	.....	40,000	40,000	80,000
Des Moines Elect & Pwr Co	Des Moines	Iowa	35,000	.....	.....	.....	.....	.....	70,000
Iowa Elec Lt & Pwr Co	Cedar Rapids	Iowa	.....	.....	.....	.....	20,000	.....	20,000
Iowa Elec Lt & Pwr Co	Boone	Iowa	.....	.....	7,500	.....	.....	.....	7,500
Kentucky Utilities Co	Paducah	Ky.	.....	.....	.....	.....	40,000	40,000	80,000
REGION V									
U. S. Government	Camden	Ark.	.....	.....	120,000	.....	.....	.....	120,000
U. S. Government	Johnesboro	La.	.....	.....	60,000	.....	.....	.....	60,000
Gulf States Util Co	Louisiana	La.	.....	.....	.....	25,000	.....	.....	25,000
Swestern Gas & Elect Co	Arsenal Hill	La.	.....	.....	.....	.....	.....	60,000	60,000
Okla. Gas & Electric Co	Arthur S Huey	Okla.	.....	.....	20,000	.....	.....	.....	20,000
Central Pwr & Lt Co	Nueces Bay	Texas	.....	30,000	.....	.....	.....	.....	30,000
Tex.-N. M. Utilities Co	Tuco	Texas	.....	.....	.....	.....	.....	20,000	20,000
Panhandle Pwr & Lt Co	Riverview	Texas	.....	.....	.....	.....	20,000	.....	20,000
San Antonio P S Co	Comal	Texas	.....	.....	.....	.....	30,000	.....	30,000
Houston Pwr & Lt Co	Deepwater	Texas	.....	.....	.....	.....	.....	30,000	30,000
REGION VI									
Nwestern Pub Serv Co	Mitchell	S. D.	.....	.....	.....	.....	.....	20,000	20,000
Otter Tail Power Co	Kidder	N. D.	.....	.....	.....	.....	.....	20,000	20,000
Pub Serv Co of Colo.	Valmont	Colo.	25,000	.....	.....	.....	.....	.....	25,000
Sthn Colo. Power Co	Pueblo	Colo.	7,500	.....	.....	.....	.....	.....	7,500
Kansas City Pwr & Lt	Grand Ave	Mo.	.....	.....	35,000	.....	.....	.....	35,000
Kansas Elec Pwr Co	Hutchinson	Kan.	.....	.....	.....	.....	.....	30,000	30,000
Empire Dist Elec Co	Riverton	Kan.	.....	.....	.....	.....	.....	25,000	25,000
REGION VII									
Utah Power & Light Co	Jordan	Utah	.....	.....	.....	50,000	.....	.....	50,000
Utah Power & Light Co	Provo	Utah	.....	.....	.....	.....	.....	50,000	50,000
City of Seattle	Lake Union	Wash.	.....	.....	.....	.....	.....	25,000	25,000
Puget Sound Pwr & Lt Co	Shuffleton	Wash.	.....	.....	.....	.....	.....	70,000	70,000
Colo.-Ore. Power Co	Coos Bay	Ore.	.....	.....	.....	.....	.....	60,000	60,000
Portland Genl Elect Co	"L" Station	Ore.	.....	.....	.....	.....	.....	70,000	70,000
REGION VIII									
Pacific Gas & Elect Co	Oleum	Calif.	40,000	.....	40,000	.....	.....	.....	80,000
Pacific Gas & Elect Co	Martinez	Calif.	40,000	.....	.....	.....	.....	.....	40,000
San Diego Gas & Elect Co	Station "B"	Calif.	3,000	.....	.....	70,000	.....	.....	73,000
Central Valley Authority	Antioch	Calif.	.....	.....	.....	.....	.....	75,000	75,000
City of Los Angeles	Seal Beach	Calif.	.....	.....	.....	.....	.....	65,000	65,000
Total			2,054,640	1,933,750	1,960,000	2,480,000	2,725,000	2,255,000	13,408,390

Transportation Struggles to Meet Peak Fuel Needs

THE UNITED STATES tops the world in the raw material of power production —fuel. This is comforting, but only part of the story. In the present emergency, the only fuel worth a nickel is the fuel that can be *delivered* to the power plant. From this realistic point of view, here are the facts:

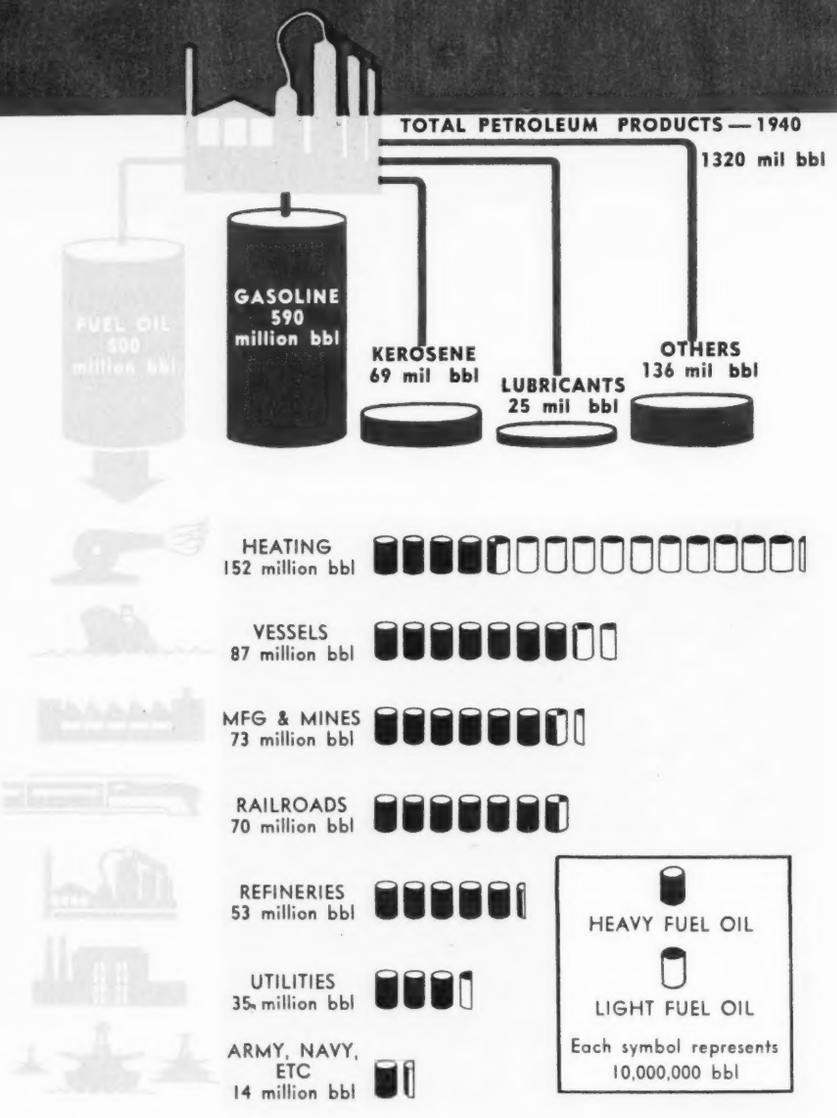
TRANSPORTATION is the only visible limiting factor on supply of any of the major power fuels. Reserves are ample, production is adequate.

THIS WINTER, America faces shortage of fuel oil on the East Coast and possible local coal shortages, both caused by transportation difficulties.

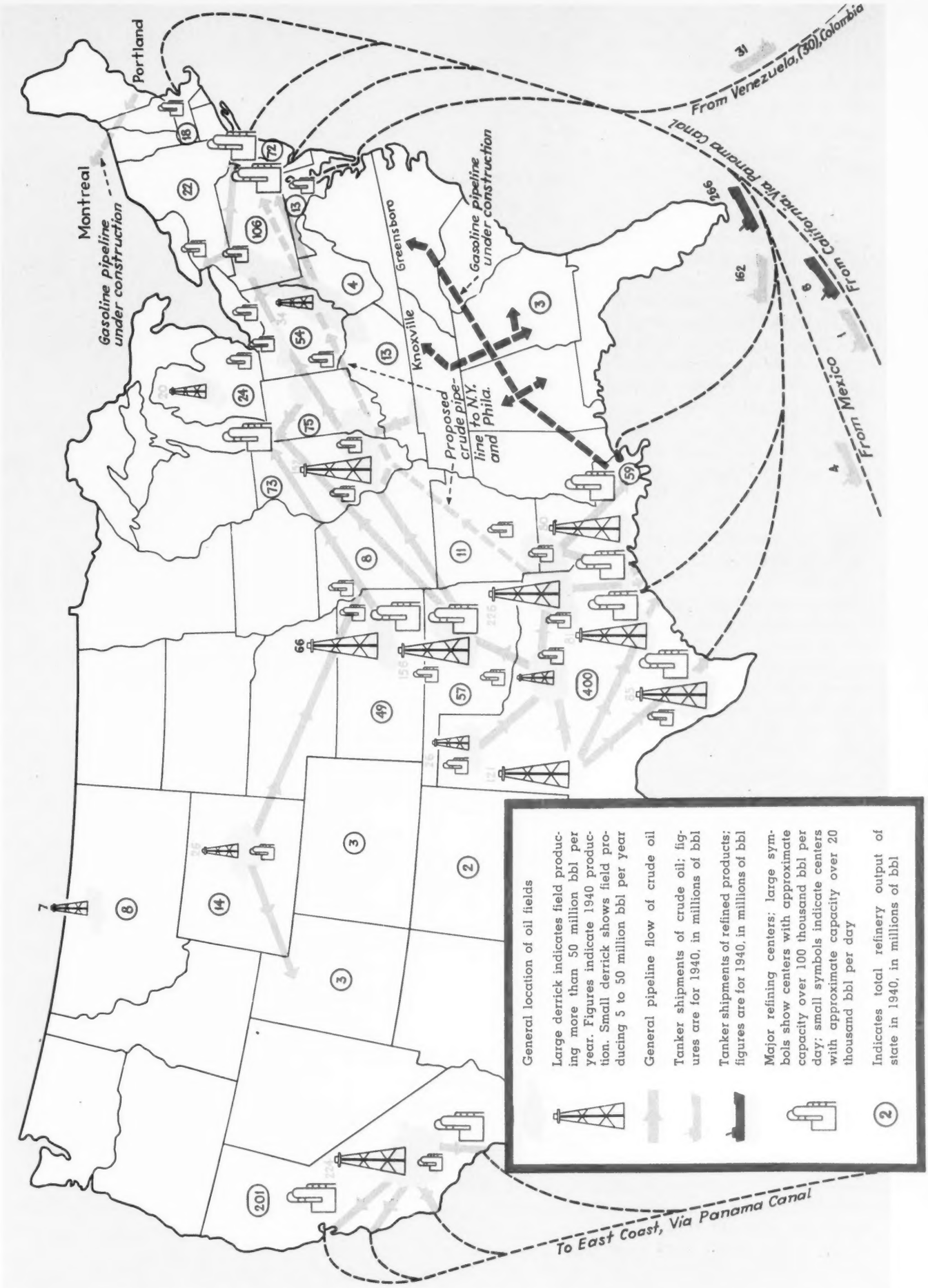
CURTAILMENT of non-essential consumption, economies in use, and emergency transportation measures will ease the fuel-oil situation and may completely eliminate the coal problem.

NEXT WINTER (1942-43), new transport facilities now being planned will handle expected requirements. Also tending to lighten the burden will be reductions in non-defense use of fuel to offset increases caused by expanding defense production.

THE POWER ENGINEER can help by increasing fuel stocks, particularly during off-peak periods; by cutting fuel use to the bone; by boosting fuel flexibility of existing equipment as much as possible; and by insisting on flexibility in new units.



The Industrial East Faces Shortage of Oil This Winter


Portland
Montreal
Gasoline pipeline under construction
Gasoline Pipeline under construction
Greensboro
Knoxville
Proposed crude pipeline to N.Y. and Phila.
From Venezuela, (30), Colombia
From California, Via Panama Canal
From Mexico
To East Coast, Via Panama Canal
General location of oil fields
Large derrick indicates field producing more than 50 million bbl per year. Figures indicate 1940 production. Small derrick shows field producing 5 to 50 million bbl per year
General pipeline flow of crude oil
Tanker shipments of crude oil; figures are for 1940, in millions of bbl
Tanker shipments of refined products; figures are for 1940, in millions of bbl
Major refining centers; large symbols show centers with approximate capacity over 100 thousand bbl per day; small symbols indicate centers with approximate capacity over 20 thousand bbl per day
Indicates total refinery output of state in 1940, in millions of bbl

Diversion of 25% of the tanker fleet normally supplying 90% of the East Coast's petroleum will force curtailment of non-essential uses this winter. Future depends on building pipelines and tankers quickly

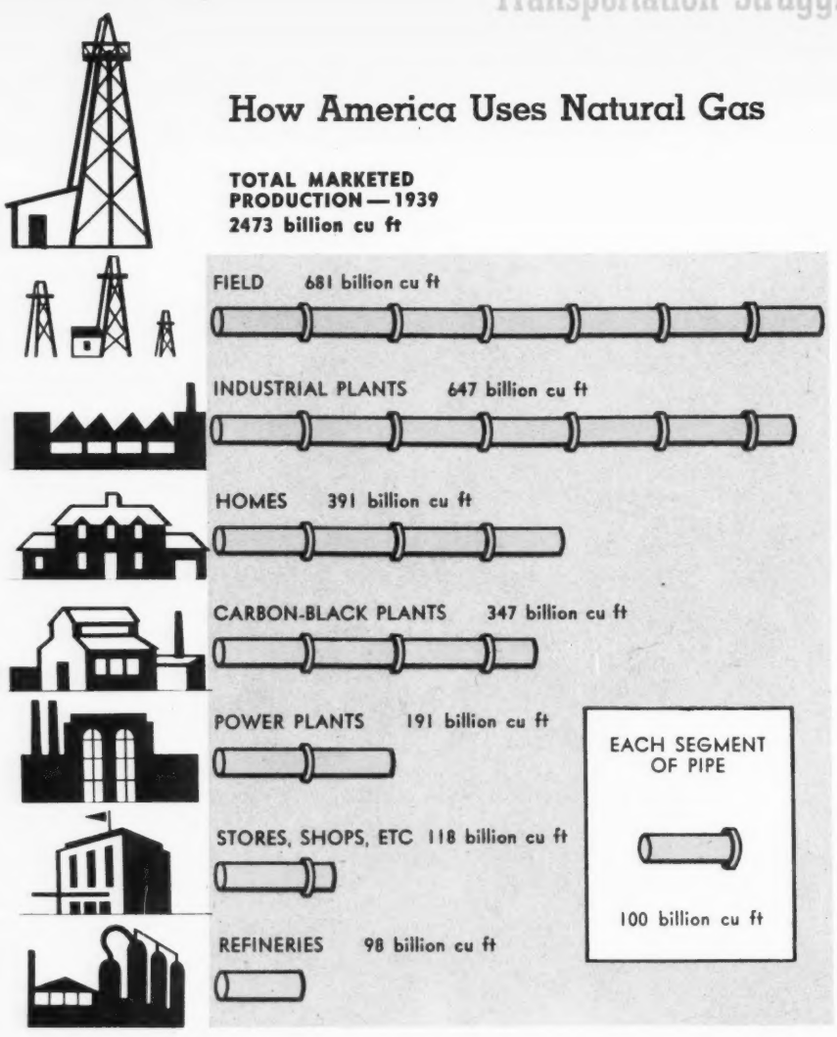
OIL Why does part of the United States, which produces half again as much petroleum as the rest of the world combined, face a possible shortage? There is no lack of crude oil; we produce more than enough for our own requirements, and imports and exports are small. Nor is there lack of reserves. Scientific exploration, deeper drilling, and improved production techniques continue to widen the gap between production and reserve supplies. During 1940, more new fields were discovered than in any single year before. We started the year with 19 billion bbl of proved resources.

Neither is there any lack of refining capacity. As of January 1940, we had 557 refineries, with a daily capacity of 4,700,000 barrels. More than 10% of this total represents plants being built or shutdown equipment that could be brought back into service.

The map on the preceding page shows plainly why we face a possible shortage. East-Coast states consume about 40% of the national petroleum output but account for only 18% of the refinery output and less than 2% of the crude production. Practically all of this vast deficiency is made up by tanker shipments from Texas, which produces 36% of the nation's crude oil and does 31% of the refining. More than 90% of the petroleum consumed on the Eastern seaboard arrives by water.

Recent surveys indicate that transfer of tankers to U. S. Navy and British service has reduced fleet capacity to the point where it can handle only about 75% of this winter's indicated demand. Further withdrawals, now under consideration, might cut capacity to 50%. Emergency measures to meet this winter's situation, such as deeper loading of vessels, rearrangement of routes, substitution of nearer sources of supply for imports, and taking over foreign-flag tankers, will help.

Other transportation methods offer little real help because existing pipeline and railroad facilities


How America Uses Natural Gas
TOTAL MARKETED PRODUCTION—1939
2473 billion cu ft
FIELD 681 billion cu ft
INDUSTRIAL PLANTS 647 billion cu ft
HOMES 391 billion cu ft
CARBON-BLACK PLANTS 347 billion cu ft
POWER PLANTS 191 billion cu ft
STORES, SHOPS, ETC 118 billion cu ft
REFINERIES 98 billion cu ft
EACH SEGMENT OF PIPE
100 billion cu ft

are at or near capacity. In spite of higher costs (2-3 mills per ton-mile for pipelines and 15-16 mills for railroads, compared to about 1 mill for tankers) existing surplus tank cars will be pressed into service as far as over-all railroad operations will permit.

To some extent, the possibility of real shortage depends on this winter's weather, since heating oil is the biggest single use of fuel oil and ranks next to gasoline in the total picture (see consumption chart on preceding page). Up to Aug. 1 governmental action was confined to encouraging voluntary reduction in gasoline use, to release tanker space for fuel oil. Compulsory curtailment by retail restrictions is now in force, with rationing likely to follow. A few industrial fuel-oil users may be able to switch to coal before winter and where at all possible, this is a wise move. For the rest, the answer seems to lie in getting the most out of every gallon burned.

New tankers and pipelines promise a solution of next winter's problem. About 150 tankers are now under construction or contract. With seaboard shipyards crowded to the limit, oil companies propose building a yard for mass production of tankers on an inland stream near one of the steel-producing centers. Finished tankers will be floated on pontoons to deep water. To build the yard and the first four tankers will take about 15 months; after that tankers will slide down the ways at the rate of 4 per month.

Most likely pipeline addition is a 24-in. trunk from a point near St. Louis to New York and Philadelphia refining centers (see map). To build this 250,000-bbl-a-day line will cost about $68,000,000 and will take about a year. Contracts have been let for an 800-mile gasoline pipeline from Baton Rouge, La., to Greensboro, N. C.

What's to prevent hoped-for fourfold expansion of defense production from upsetting the apple-cart by lifting consumption to unexpected levels? Any such rise must be accompanied by drastic reduction of consumer-goods production which will serve as an offset and keep fuel-consumption increase to reasonable levels. Even more important, major uses such as gasoline and heating oil will be relatively unaffected by expanded activity and gasoline, is, to some extent, non-essential so that consumption can be cut.

COAL

The possibility of local coal shortages this fall and winter exists but the odds are that the railroads will meet the situation even though the margin may be extremely small.

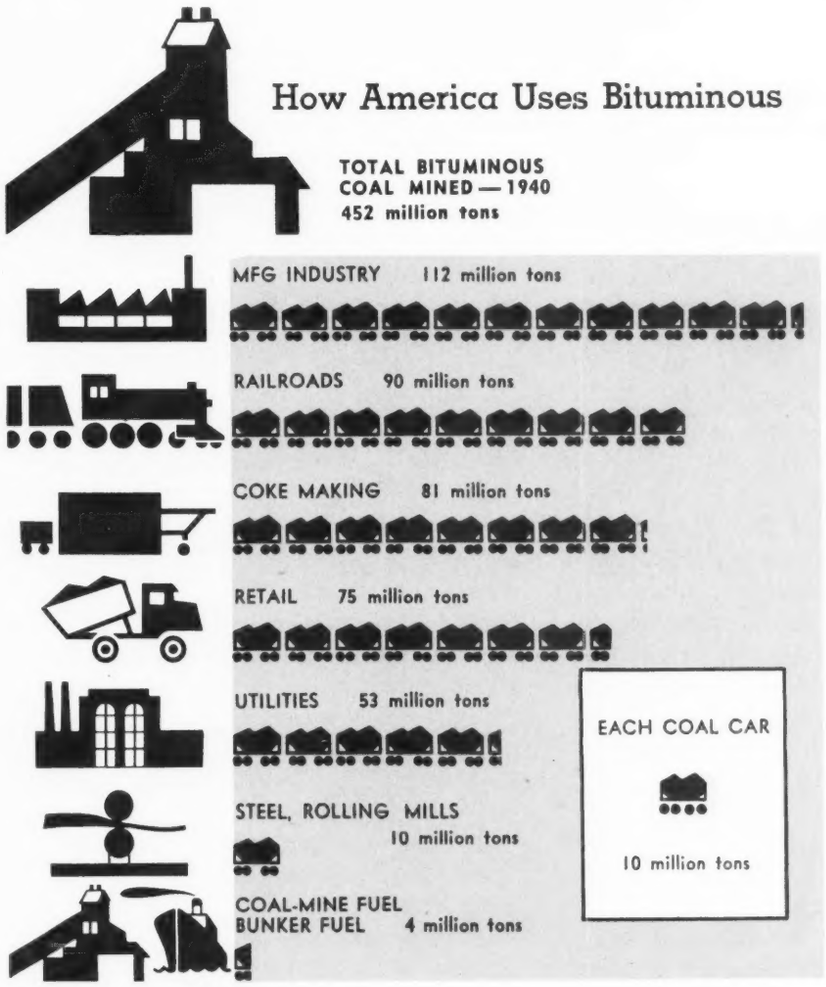
With exception of shipments by tidewater to East-Coast ports, across the Great Lakes, and along some inland waterways, most coal moves by rail, constituting, with coke, a little more than a third of total rail traffic. Grain and iron ore form the other large bulk movements. With all three hitting a peak in the eight weeks from mid-September to mid-November, the railroad problem boils down to having enough cars in service to handle peak traffic volume.

Government agencies estimate the weekly peak this Fall will run close to 1,050,000 carloadings, while railway association executives put the figure at 940,000. In spite of a marked decrease in rolling stock compared to World War days, and in spite of today's higher obsolescence, increases in average freight-car capacity and locomotive power and speed, and important gains in operating efficiency will permit satisfactory handling of the traffic load expected by the railroads. Thus, likelihood of a jam depends largely on whether the railroads' traffic estimate is better than the government's.

In the Fall of 1942, carloadings will go to 1,550,000 per week, say government agencies, contending that the railroads should buy 250,000 more cars as fast as they can be built. Car shops now work one shift and claim to be limited by difficulty in getting steel and labor. Priorities will probably help and car building will expand.

Mine production has run as high as 10-11 million tons per week this year and could probably go to 13 million if the demand existed. Immediate increase in output can come only from increasing labor forces or number of operating shifts; mechanization will play an important part in future expansion. Limitations lie in obtaining equipment (which now carries only a fair priority rating, but may get a better one), possible labor shortage, and exhaustion of existing properties, requiring opening new ones.

Demand should not exceed mine capacity because: (1) about one-quarter of total consumption consists of uses not directly affected by defense activity (heating for example), and (2) heavy increase in defense manufacturing must be offset by reduction in non-defense production, which will mean a rise in industrial fuel consumption in the order of possibly 25-35% rather than several hundred percent.


How America Uses Bituminous
TOTAL BITUMINOUS COAL MINED — 1940
452 million tons
MFG INDUSTRY 112 million tons
RAILROADS 90 million tons
COKE MAKING 81 million tons
RETAIL 75 million tons
UTILITIES 53 million tons
STEEL, ROLLING MILLS 10 million tons
COAL-MINE FUEL
BUNKER FUEL 4 million tons
EACH COAL CAR
10 million tons

GAS

Resources can more than meet future demands; existing natural-gas pipelines will be able to handle this winter's load without difficulty. Indications are that one or more of the proposed pipelines for which applications have been filed with FPC, including lines from Louisiana and Texas through the southeast to New York, and lines north from southwestern fields to the Middle West, will get under way shortly.

Availability of supplies from major fields will relieve the situation in the Appalachian region where increased defense-plant demand threatens future curtailment of domestic and commercial use.

Equipment Makers Keep Pace With Record Demand

EXPANSION of power facilities depends on ability of utilities and, to a lesser extent, industrial power plants, to secure the necessary turbines, condensers, boilers, and other items of equipment. Orders, based on private estimates of 1942-43 loads, now practically fill manufacturers' shops, along with an even greater volume of naval and marine work. In three years (1941-43), builders will turn out more than 6,000,000 kw of central-station units and more than 16,000,000 hp for ships.

If present plans hold, 1944-46 will see the first application of a totally new philosophy—gearing power-supply expansion to maximum rate of equipment production. The FPC program (see page 73) was laid down after consultation with turbine makers revealed ability to produce approximately 8,000,000 steam kw from 1944 through 1946. In effect, the production was allocated among utility systems according to Federal load-growth estimates. Size and location of units, dictated by system conditions, will be fixed cooperatively at regional conferences of FPC, OPM, and utility representatives.

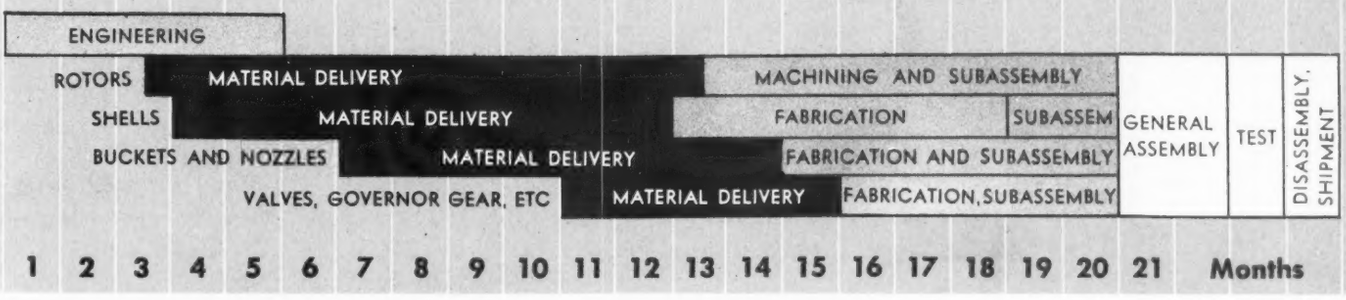
Whether governmental action will go beyond this preempting of production facilities and preparation of a master plan remains to be seen. It seems possible, at least, that the plan will be altered in any way necessary, even to indicating where orders should be placed to keep shops filled and to shifting allocation of units in production whenever special needs arise.

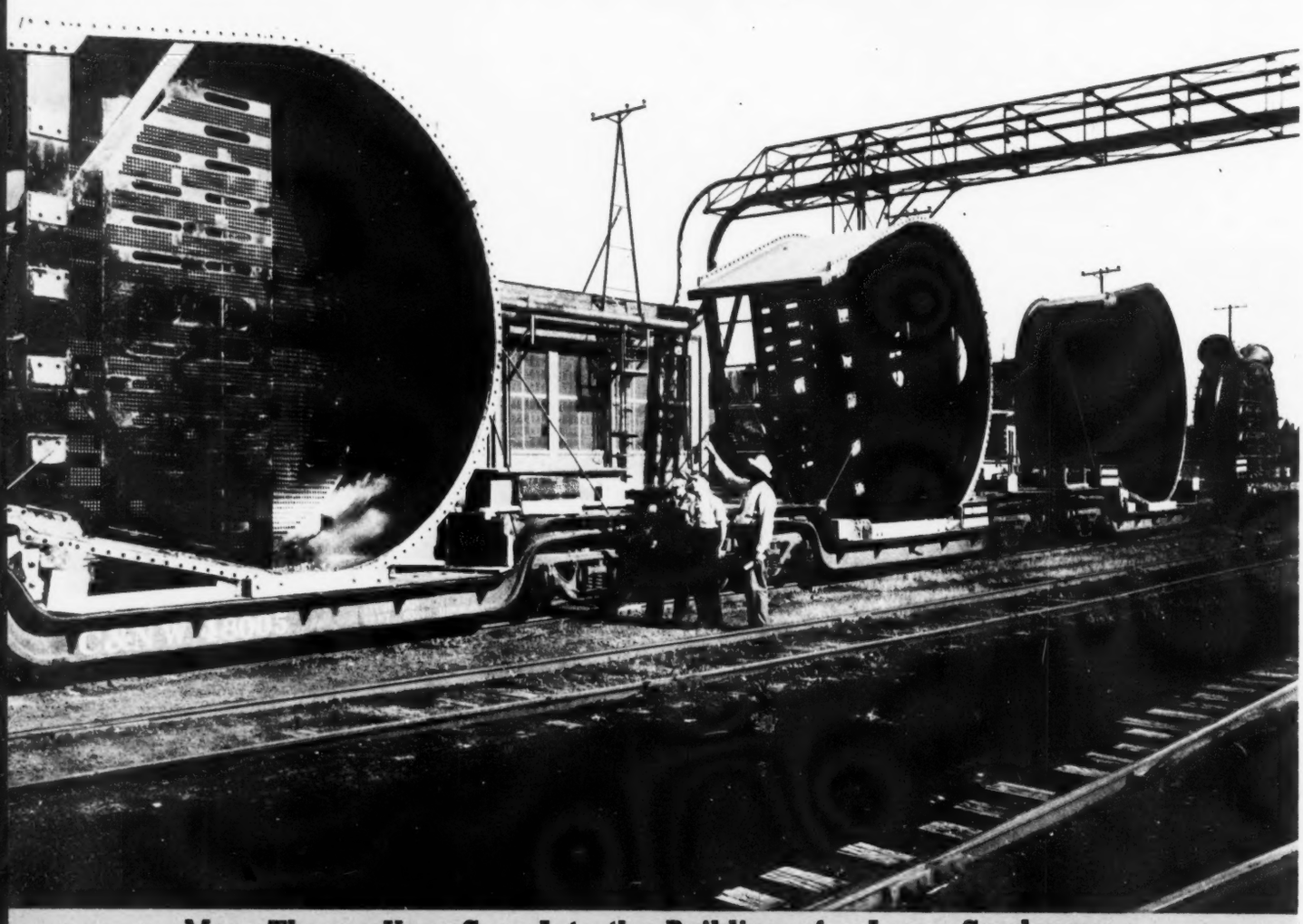
Present delivery quotations on all power equipment reflect serious but unavoidable delays in securing raw and partially fabricated materials such as heavy steel plate, forgings, large castings, tubing, and special alloys. Orders for these items must take their turn at mills overloaded with orders from the Army, Navy, and defense industries. Thus, although actual fabrication of power equipment has been speeded by improvements in design and manufacturing technique, time between contract and commercial operation has increased 25-50%.

TURBINE building proceeds approximately as shown in the chart (right) for a typical central-station unit. With delivery of rotor forgings and large castings the present controlling time factor, orders are placed as soon as engineering progresses sufficiently to fix dimensions. Work on other parts proceeds at a rate which will bring parts and subassemblies to completion in time for final assembly and test.

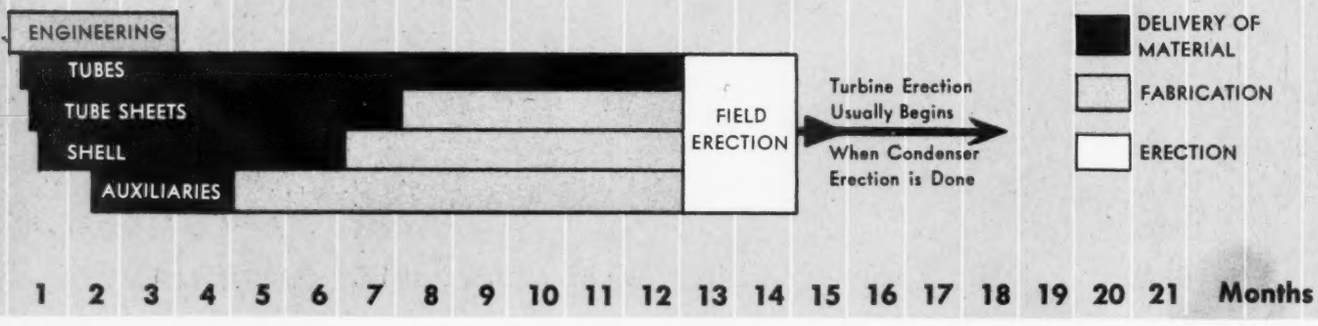
Over-all delivery time can be cut by ordering duplicate units and by avoiding special designs. This simplifies engineering and permits quick placing of material orders. High priority ratings, where obtainable, expedite material deliveries. Standardized industrial turbine-generators can be delivered in about 12 months, with priority release of materials.

It Takes Over Two Years to Put a Typical Large Turbine on the Line





More Than a Year Goes Into the Building of a Large Condenser



CONDENSERS take least time to build of any major equipment item, but are usually partly installed before turbine erection starts. Number and length of tubes is fixed early and the order placed to insure delivery to the job when needed. Other parts are fabricated in time to permit shop assembly of shell (or sections on large units) and tube sheets. Field erection involves setting shell, mounting and connecting auxiliaries, and tubing. The chart shows time required for a large condenser; smaller units can be furnished more quickly.

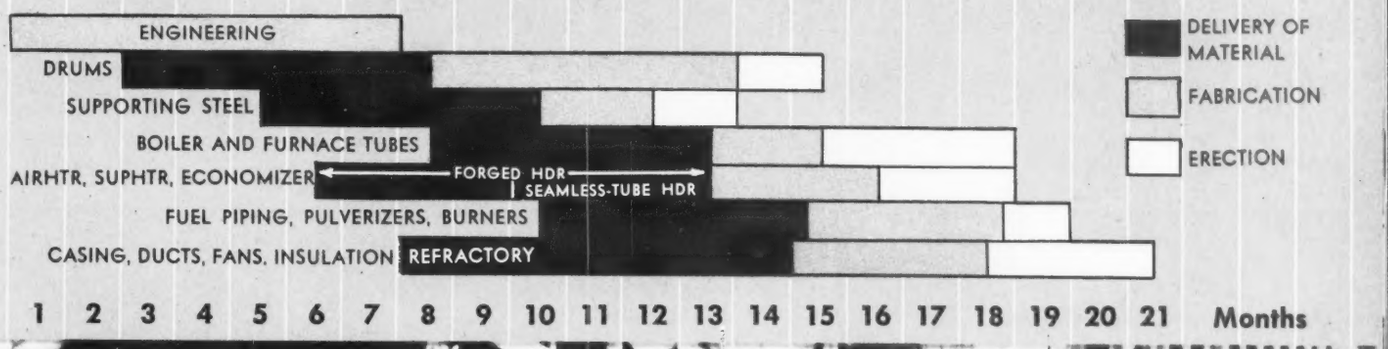
Problems of material delivery apply to all kinds of power equipment. In addition, many items, instruments for example, are influenced by heavy demand from industries outside the power field. So far makers have met all demands and will probably continue to do so.

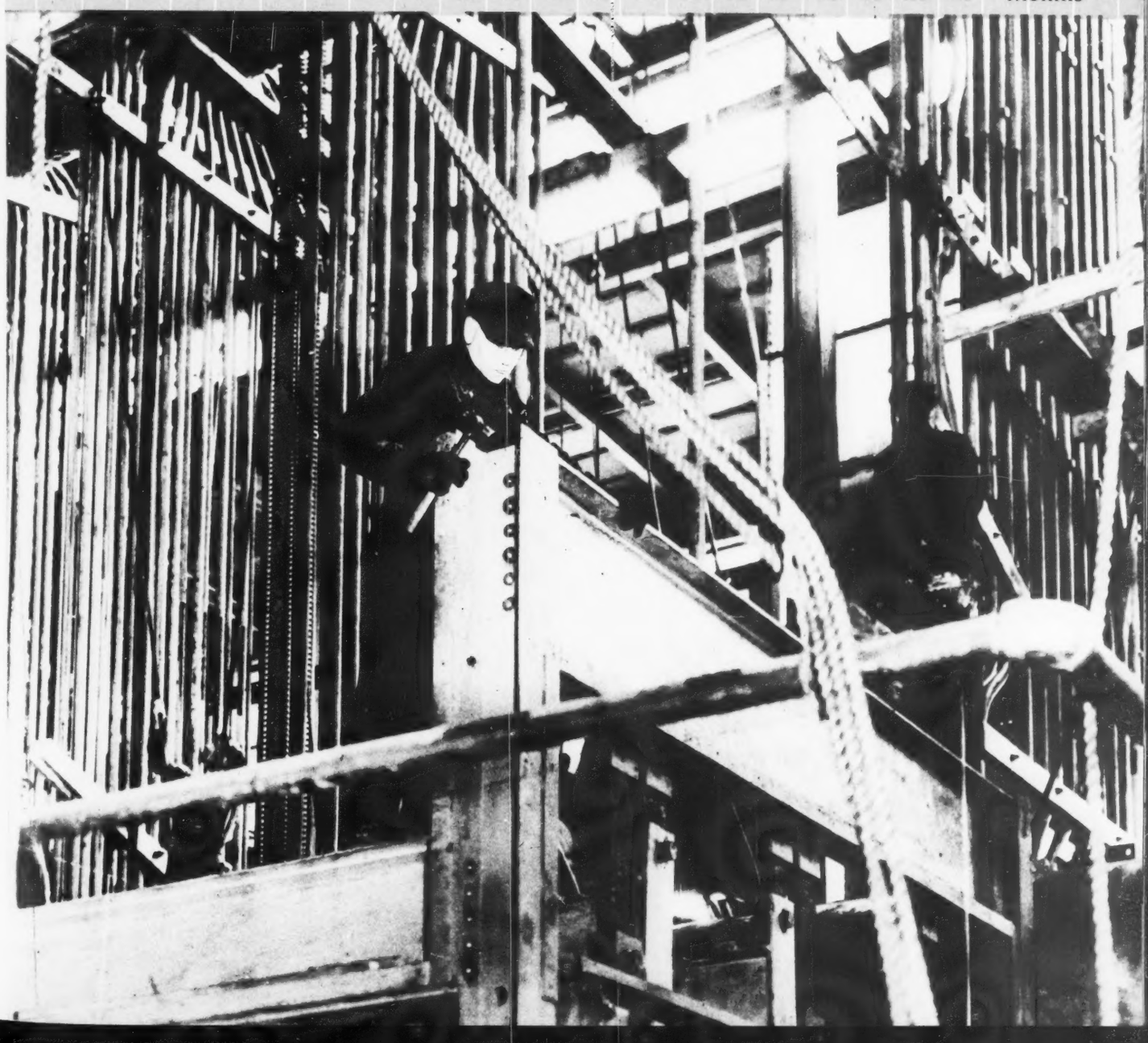
BOILER building is characterized by shop fabrication of unit parts and subassemblies for step-by-step erection in the field. Since delivery of drum plate now takes from 4 to 6 months, depending on size and thickness, and drums are needed early in the erection sequence, plate orders must be placed as soon as engineering permits. Lengthening delivery time on tubing (especially alloy) and other necessary ingredients puts further emphasis on the quick placing of orders for parts and materials.

Time can be saved in the engineering stage by close cooperation between customer and builder. This includes avoiding special requirements, clearly stating conditions, prompt handling of engineering questions and approvals.

Smaller boilers, of standardized design, can be produced in 6-12 months, depending on priority, as contrasted with almost two years for new large central-station units.

It Takes up to Two Years to Build a Typical Central-Station Boiler





Skilled Manpower Stands at the Throttle

WHAT SORT of engineers design, build, service and operate America's power plants? What are their responsibilities? What is their experience? Can they meet the demands of the defense emergency? The best way to answer such questions is to look at the men themselves as exemplified by these typical power teams.

Differing greatly in background, and in the size of their individual jobs, all the men pictured here are power engineers. All are key men in the sense that America's industrial and defense machinery could not operate without them. All have the engineer's direct factual approach to practical problems. All, regardless of education, are men of *wide experience*.

This last point is worth stressing. Nothing can replace experience on a power job. The obvious defense lesson to governmental authorities and others is that power engineers should be kept at their present essential work throughout the emergency.

LARGE UTILITY Vital to defense are the generating facilities of Consumers Power Co, serving industrial Michigan outside the Detroit area. Left to right: Mackenzie, Boyce, Foote, Daniels

LARGE UTILITY

Frank G Boyce is vice-president of Consumers Power in charge of electrical production, transmission and construction. J W Mackenzie, mechanical engineer, supervises mechanical functions of all Consumers steam and hydro plants.

J H Foote heads the general Engineering Dept of C & S Northern Div, (Mich., Ohio, Ind., Pa.) This department investigates, estimates, recommends, plans and specifies all construction required by Consumers and other C & S companies. Mr Foote is also chief engineer of Consumers Power. George C Daniels, mechanical engineer for Commonwealth & Southern, is responsible for design and construction of steam-generating plants, Northern Div.

SMALL UTILITY **Typical central-station power team is this group of engineers, Iowa Electric Light & Power (and associated companies), Cedar Rapids. Left to right: Mead, Howe, Kvapil (standing) Ingham, Myers, Brown (standing) Stewart, Drabelle**

SMALL UTILITY

John M Drabelle, mechanical and electrical engineer for Iowa Light & Power Co, Central States Electric Co, Iowa Electric Co, Cedar Rapids & Iowa City RR, is boss of power plants, transmission and gas.

Ray Ingham, general superintendent of Iowa Electric and Central States Electric, is in charge of operation. H G Mead, general superintendent of overhead lines for Iowa E L & P, supervises outside transmission lines and electrical distribution.

J W Howe, assistant electrical engineer for Iowa E L & P, is in charge of power-plant and substation electrical construction. D J Kvapil, assistant mechanical engineer, heads up design and construction of steam and power stations. C B Myers is purchasing agent for Iowa E L & P and its associated companies.

H W Stewart, general foreman for Iowa Electric and Central States Electric, directs maintenance and construction of transmission and distribution. Harold Brown, chief electrician for Iowa E L & P, supervises electrical calculation, relaying, metering.

CONSULTING ENGINEER

Francis J Sill's twenty years of power-plant consultation have twenty years of varied technical experience back of them. Courses taken in several schools in the New York City area rounded out his extensive training.

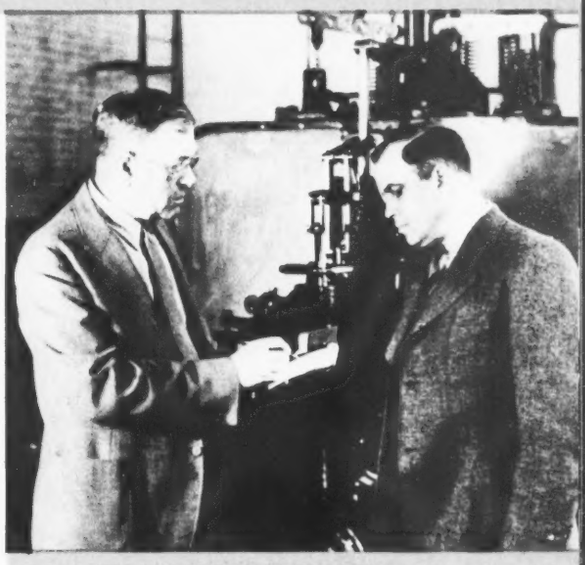
Kenneth R Warrington, his associate, had long experience in civil and mechanical design and construction of power plants before joining Sill in 1929.

MUNICIPAL

H C Major, commissioner of public utilities since 1926, is a Columbia BS in ME. After experience in the plant and on distribution and transmission, he came to Rockville Center as chief.

Wallace M Payn, chief engineer since 1926, is in charge of power and pumping plants. After high school, Payn did steam fitting, then came to Rockville Center as meter reader and fireman.

W E VanDeusen, first assistant engineer since 1926, is in charge of all mechanical maintenance in power and pumping plants. Early experience included coil winding and motor repairs.

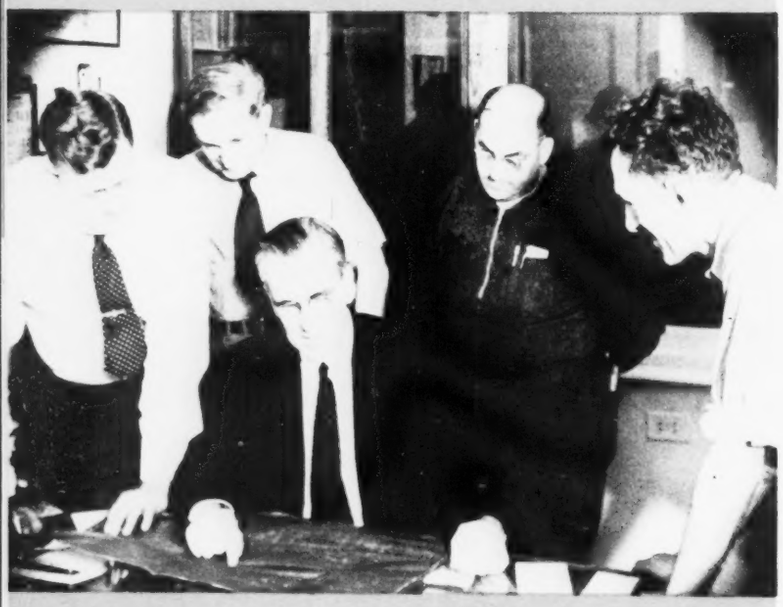


CONSULTING ENGINEER **Typifying the private power consultant, Francis J Sill (left), Westboro, Mass., checks data with his associate Warrington in a client's plant**

MUNICIPAL **The Dept of Electric Light & Water, Rockville Center, Long Island, N. Y., is a good example of municipal power and of diesel generation (10,600 hp). Left to right: Payn, Major, VanDeusen**

CONSULTING FIRM The large engineering corporation devoted to design, construction, operation and management is typified by Stone & Webster Engrg Corp (and affiliates), Boston. Left to right: Argersinger, Klein, Ryan (standing), Pope, Wood (standing), La Crosse, Clark

INDUSTRIAL Power staff of Pennsylvania Sugar Co, Philadelphia, is typical of many large and medium-sized industrials. Left to right: Smith, Stockman, Gutleben, Dost, Banks



INSTITUTION With steam engines, diesels, air conditioning, etc, the New Yorker Hotel, N. Y. C., illustrates the complex engineering organization required by modern buildings and institutions. Seated: Lewis; (left to right) Moffett, Seiders, Campbell, McKibben

CONSULTING FIRM

Emmart LaCrosse, vice-president (since 1933) and engineering manager, is in charge of all engineering. Broad experience in both utility and industrial power plants and buildings. With Stone & Webster since 1916.

Joseph Pope, vice-president since 1940 and consulting engineer since 1926. Holds BS degree in Naval Architecture, MIT, 1908. After work as shipfitter, machinist, student engineer and plant operator, came to Stone & Webster in 1909. Roy E Argersinger, assistant engineering manager since 1929, has BS and MS degrees from Union. With Stone & Webster Engineering Corp over 25 years.

Frank S Clark, consulting engineer since 1926. Owns a CE degree from Penn. Military College in 1901 and wide experience in designing and building power plants. With Stone & Webster since 1912. A C Klein, chief mechanical engineer since 1929, was graduated from Stevens in ME, 1908. His early record: railroad apprentice, cadet engineer, assistant engineer and staff engineer with United Gas Improvement Co, ordnance officer.

Henry B Wood, chief electrical engineer since 1929, came out of Purdue in 1906 with a BS in EE. With Stone & Webster since 1917; has wide experience in electrical testing, sales and electrical engineering. W F Ryan, assistant chief mechanical engineer (appointed 1941). Served as power engineer for several corporations. AB from Harvard, 1911, and MME two years later. With Stone & Webster Engineering Corp since 1929.

Not shown in the photograph are E Burnley Powell, consulting engineer since 1920 on power stations; Henry L Bunce, Jr, assistant engineering manager since 1929; Ernest A Dockstader, chief structural engineer; and Harry J Klotz, chief power engineer. All have been with Stone & Webster over 20 years, and possess wide training in the operation, design and testing of power plants.

INDUSTRIAL

Dan Gutleben, plant engineer, is in complete charge of all engineering. Alsatian born, raised on a Nebraska ranch, U of Nebraska graduate, Gutleben got his early training in steel mills and construction. In 1921 he took charge of engineering at Penn. Sugar.

Thomas W Stockman, steam engineer, is boss of all steam and electrical generation. Irish born, worked in Glasgow, went to sea as an oiler. 14 years firing in Philadelphia, then chief fireman for Penn. Sugar.

Herman Dost, chief electrician, is responsible for all electrical construction and maintenance. "Wizard" Dost is a high-school graduate and

did electrical work for Philadelphia Transit. With Penn. Sugar 25 years.

Newton Smith, Gutleben's assistant, is a high-school graduate with drafting experience. Finishes drawings for the boss and is his "eyes and legs" around plant. Sam Banks, engineroom foreman, came to Penn. Sugar as a trained machinist.

INSTITUTION

Warren Lewis, chief engineer at the New Yorker since it opened in 1929, is in charge of all power services. A mechanical graduate from Pratt (1910), he has served as apprentice in NYC RR shops, was an operator for Brooklyn Edison and Bush Terminal, chief engineer of the Bradstreet Bldg and assistant chief of the Metropolitan Life Bldg.

D H Moffett, assistant chief since 1932, is Lewis' right-hand man. Experience: machine apprentice, 15 years at sea up to chief engineer, Interborough Rapid Transit power plant, assistant chief in a hospital. Joseph Seiders, chief electrician, came up the line from an electrician's helper and apprentice machinist.

Edgar McKibben, watch engineer, directs 13 men in day shift. His record: dynamo wiper, fireman, boiler-room engineer, relief engineer, night watch engineer. Richard Campbell, chief machinist, has charge of a trouble-shooting gang of six men.

MANUFACTURER'S ENGINEERS

Vice-president in charge of engineering. Has been identified with fuel-burning and steam-generating equipment for more than 35 years and has pioneered many large high-pressure units.

Vice-president. Responsible for design and development of a standard 2-drum boiler, and a byproduct chemical-recovery unit. Heads Marine Dept.

Head of research, authority on combustion. Formerly in charge of government fuel investigations.

Chief engineer. Service covers the period of development of the modern steam-generating unit.

PROFESSOR AND STUDENT

Professor J I Yellott, Director ME Dept since 1940, was born in Maryland. Holds BE and MME degrees from Johns Hopkins. Taught at U of Rochester and Stevens Tech. Has done pioneer researches on steam flow and consultation for many firms.

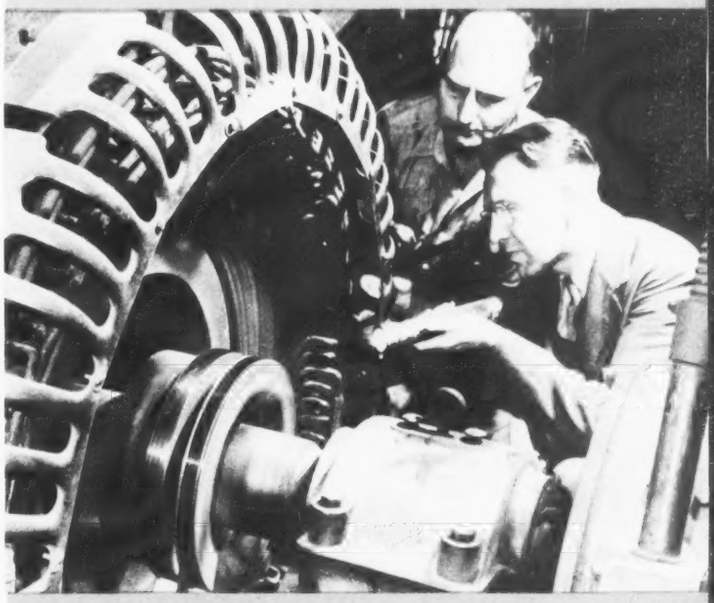
Robert J Bartusek, 23-year-old graduate student and research assistant, Armour Research Foundation, teaches elementary machine design, helps on engineering defense program and does steam research under Professor Yellott.

SERVICE ENGINEER

H C Linderman checks a large synchronous motor driving copper strip mills at C G Hussey & Co, Pittsburgh. Electrical superintendent Wilson (left) keeps motors running in a plant turning out 2,000,000 lb of copper shapes monthly, mostly for defense.

MANUFACTURER'S ENGINEERS **No picture of the power engineer is complete if it omits the manufacturer's engineers. The executives in this typical group appear left to right in order of description**

PROFESSOR AND STUDENT **Power man in the making, research assistant Bartusek picks up tips on steam flow from Prof Yellott (right) at Illinois Institute of Technology (Chicago)**



SERVICE ENGINEER **Because responsibility for correct application often falls on the equipment manufacturer, his service engineer (right) is a key man in the power field**

Research Shapes Future Power Pattern

WITHIN A FEW SHORT YEARS America will be infinitely better equipped and staffed for research than any other nation. The belligerents have had to concentrate their research efforts on projects of immediate military importance. This country is not yet being bombed out of its laboratories and has besides a large number of scientists and trained workers who can be left at their present tasks without impairing the defense effort.

To visualize the importance of organized staffs engaged in both fundamental research and applied science, one has only to review the changes in our industrial picture wrought by the first world war and the two decades that followed. Those who wonder what things will be like "after the shooting's over" may be considerably encouraged by the fact that much of our present industrial establishment can be traced back to the influences of 1918.

America entered the last war with about 8,000,000 kw of public power supply and something over 18,000,000 of prime movers in manufacturing plants. Intervening years have increased the industrial plant to 21,000,000 hp and added 34,000,000 kw to the central stations. If someone in 1920 had predicted that use of electricity would rise from 43 to 145 billion kwhr, he would have been hard put to explain just how the nation would be able to consume so much power and light.

Again we face a period in which a large amount of generating capacity will be installed to make munitions and military supplies. No peace-time use for part or nearly all of nearly 20,000,000 kw now projected can be foreseen. Here again, however, history shows that research answers the call of a need.

The first world war fathered the fixation process of atmospheric nitrogen, a large power user. This process produced nitrates for explosives as a substitute for Chile saltpeter, and after the war the entire equipment was turned over to make fertilizer for the farms of America.

That war also sired the submarine detector and the depth charge; this one has already brought forth the "degausser" demagnetizer to protect ships against magnetic mines, and has seen the use of the high-altitude bombsight. Many more closely guarded military innovations are undoubtedly under way shrouded in the cloak of official secrecy. The equally important developments in industrial materials and methods appear much later after they have been applied to consumer goods.

The material shortages of 1916 were chemicals, dyes, medicines and optical glass, none of which are on present critical lists. By 1918 we had become nearly independent of imported strategic materials, including diphenylamine, an ingredient of smokeless powder that prevents deterioration, previously obtained

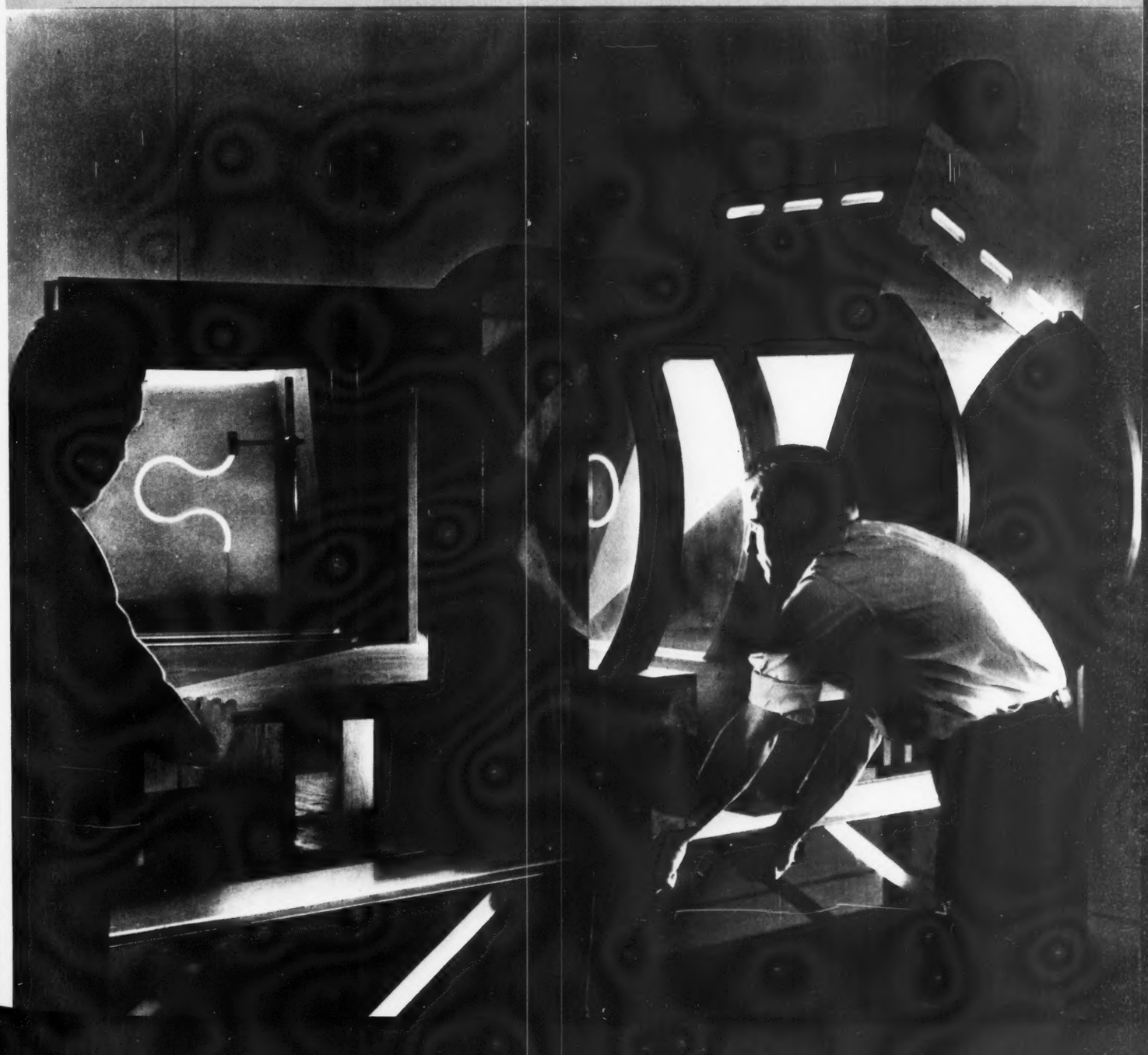
only from Germany. Today we manufacture all the materials that gave the nation's leaders sleepless nights 25 years ago. Strategic-materials lists now consist almost entirely of metals with the possible addition of rubber. The problem of supply is quite different. Much larger tonnages are required.

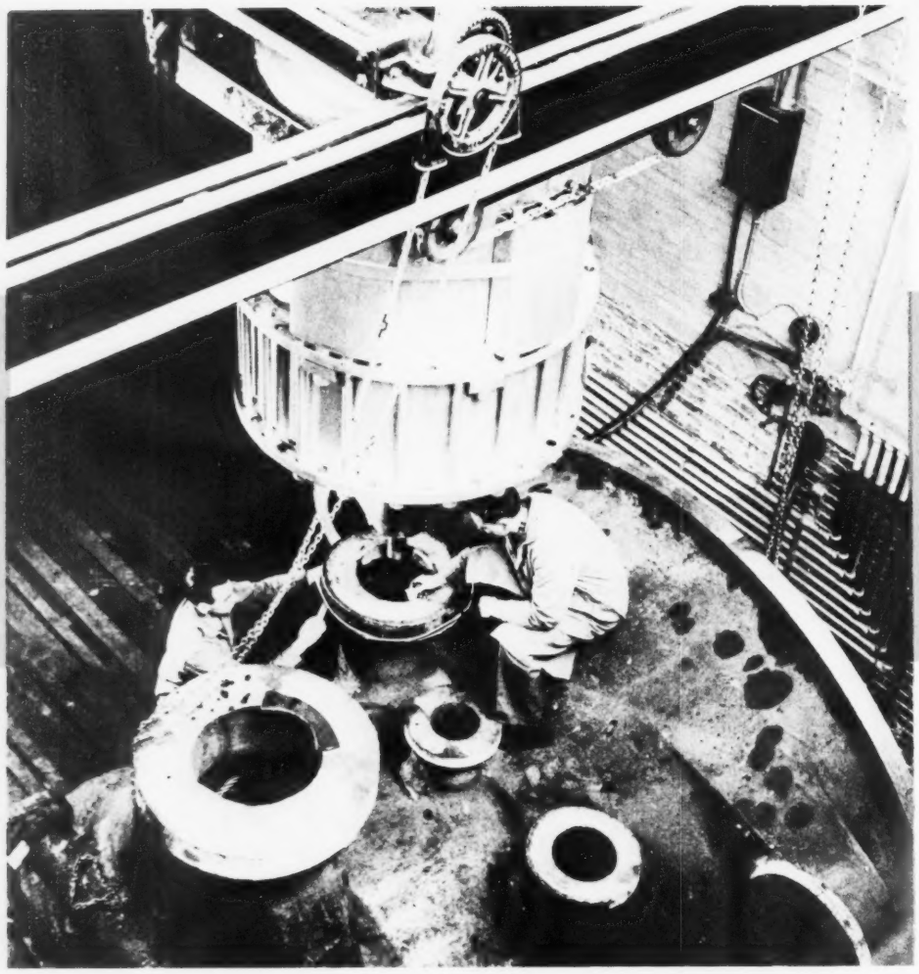
America entered the first world war a bad second to Germany in scientific knowledge and technical skill; this time we are already her equal and probably her superior in all but military matters. We have 72,000 scientific research workers in 2200 laboratories. These men represent a tremendous potential resource for developing new materials and methods, a treasure not possessed by any other nation. True, some of these 2200 experts have turned their attention to weapons and defense, but many still remain engaged in finding better things for normal living.

Every trend is toward greatly increased use of power. Aluminum, magnesium, rubber substitutes and chemicals call for electrical energy as an essential ingredient of the material itself. Fabrication by welding, so important to today's high-speed production lines, requires a few amperes to do the stitching. Most normal manufacturing operations of machining, forging and rolling now depend on electric power. Open the switches to our manufacturing plants and we are defenseless.

Just as applied research has affected military strategy and increased industry's need for power, so have twenty years of development revolutionized power-generating equipment. The search for more efficient steam cycles has con-

Model testing finds wide use in stress problems. Here a plastic miniature of a pipe bend is observed under polarized light as it is subjected to stress proportional to model size. Shadows like the grain in wood indicate amount — far apart low stress, close together high stress





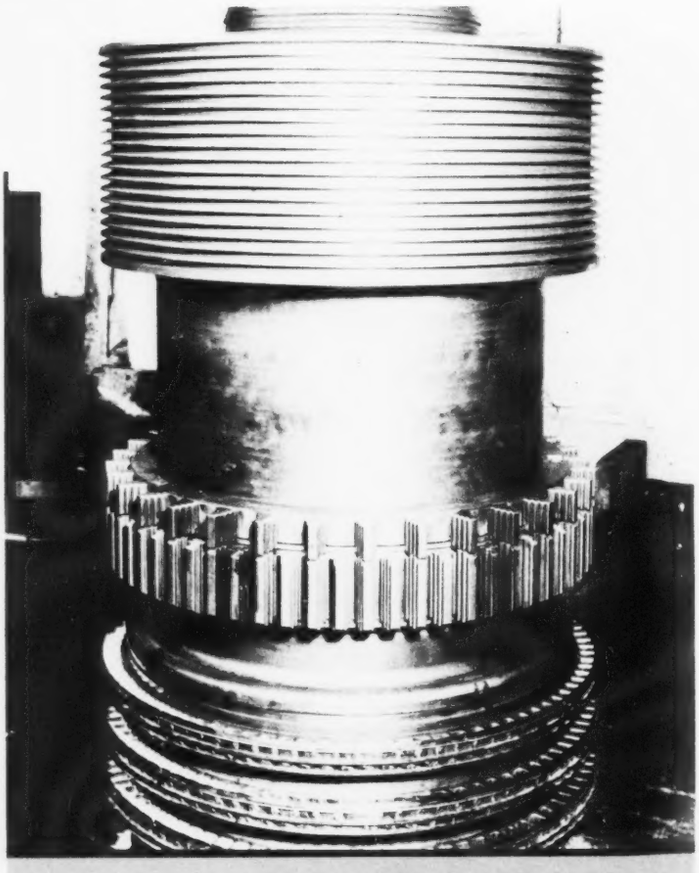
Newly developed million-volt X-ray equipment can penetrate eight inches of steel or greatly decrease time of exposure for thinner metal. Result is speeded-up production of turbine castings and boiler-drum welds

stantly demanded higher temperatures and pressures. These in turn have called for materials to stand the more severe service. The laboratories have responded with alloys that stand up better at temperatures above 900 F and pressures above 1000 lb than the former materials did at much lower steam conditions.

Although the primary objects were reduction of coal consumption and less initial cost, operators continually stressed dependability and trouble-free long-time runs. Step by step and trouble by trouble weak points have been discovered, the problems returned to the laboratories and their suggested solutions tried out in the plants themselves.

High on the list of contributions to reliability in continuous operation have been the removal of practically all brickwork from large boilers by installing completely water-cooled furnaces, much improved and simplified coal-pulverizing arrangements for large installations, and welded construction of boiler drums, piping and practically all pressure vessels.

The products of research find their way into power-plant design by devious methods. The evolution of the water-cooled furnace took place over a long period of years by the good



Axial blade slots, previously developed for fastening large low-pressure blading, now hold first-stage wheel of a high-pressure topping turbine. All blades are arranged around the spindle and forced into slots at the same time, which keeps stresses low in the blade roots

old-fashioned cut-and-try method, but the resulting problem of slag formation on furnace walls taxed the best brains of the boiler industry. Pulverized-fuel firing waited long for adequate measuring and feeding equipment as well as for pipe materials and efficient burners.

Welding of drums and pipe where a flaw might mean a serious explosion became safe only after X-ray or radium inspection disclosed weakness or indicated sound welds. Now 1,000,000 volts on the X-ray tube cuts inspection time by ten to one and penetrates eight inches of steel. Welded piping saves forging, results in simpler layout and never leaks.

Turbine blades wear hard protective shields to reduce moisture erosion in low-pressure stages; others have heavy roots or are slotted axially on the hub to stand the terrific impact of steam twenty times as heavy as air. Fan wheels wear longer because of beads of hard facing. Thorough treatment of feedwater keeps down scale and corrosion, once a frequent cause of outage.

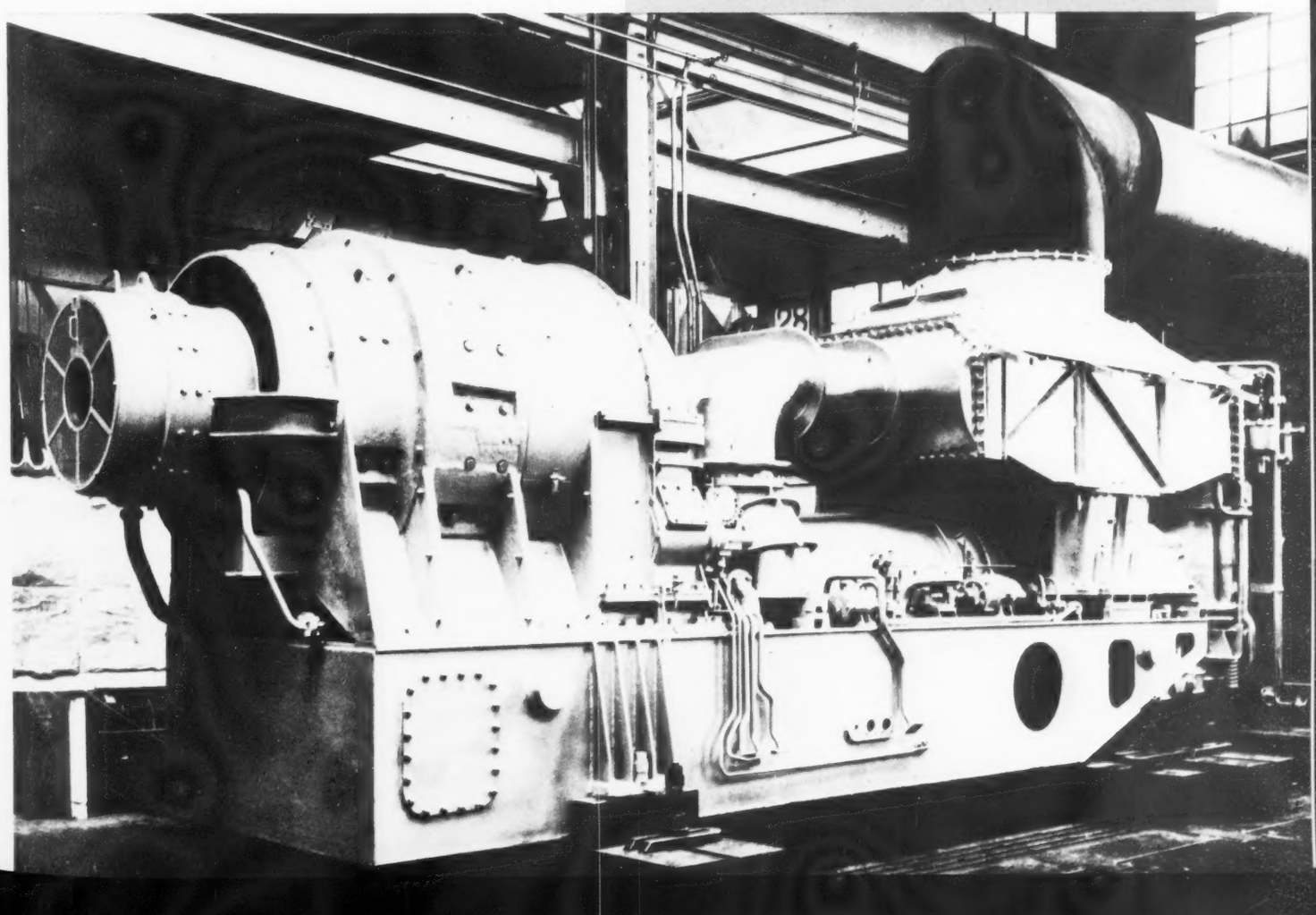
Fundamental research in metals has given us condenser tubes that last twice as long. Bacteriologists discovered effective treatment for sea water to prevent marine growth on heat-transfer surfaces. Practical trial has already selected the good and useful. The power-plant of today is as different from that of 1920 as is the modern automobile compared to the Model T.

Little advancement in power-plant practice is to be expected in the next few years. The race is on to get in all the kilowatts possible. New construction will be standardized along the lines of plants already installed so that special engineering and shop work will be reduced to a minimum on both boilers and turbines. Fortunately for power men, present designs have been refined and have a high degree of dependability as well as efficiency.

The future is not a closed book. The mercury cycle is beyond the laboratory stage. The automatic-extraction turbine still has possibilities for heat balance in connection with process steam demands that have not been completely utilized. The gas turbine presents brand-new possibilities as a power-generating unit, either stationary or mobile. And of course, atomic power intrigues the mind with its potential concentration of fuel.

The most important job for research from the power man's standpoint is the working out of new uses for the huge amounts of power that will be available in whatever kind of peace may ultimately come. America will have, in its expanded plant and organized research, the best chance of any nation to survive in the inevitable reconstruction period. This nation must take charge of the advancement of science for the entire world.

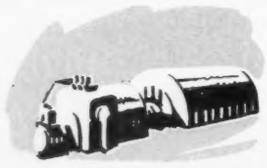
Research in air-foil design for airplanes provided knowledge for building the self-contained gas-turbine air-compressor set shown here. This one, manufactured in Switzerland for driving a locomotive, is similar to more than a dozen operating in America



Stripped Down and Streamlined—

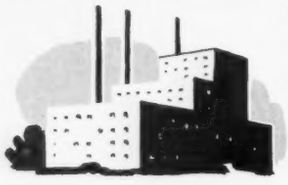
Here Is the Groundwork for the Job Ahead

POWER FOR PRODUCTION



Nothing but the valor and strength of individual soldiers won ancient wars. Modern wars are increasingly fought with death-dealing machines. Because bare-fisted courage can no longer win battles, the machines of warfare must be backed more and more by the machines of production. And because all the wheels of this immense industrial defense establishment must be powered, it is fair to say "Kilowatts win the modern war".

AMERICA BUILDS



When Hitler marched through France industrial prime movers and central-powered motors put 50,000,000 hp behind the wheels of America's manufacturing industries. These industries were buying 42 billion kwhr yearly and adding 29 billion kwhr plus 22 billion mechanical hphr from their own plants.

Central stations must bear the brunt of the defense electric load growth, while present industrial power units are used to the limit. Those who plan new defense projects should study the map of power facilities.

Engineers foresee no general power shortage, but are nevertheless committed to a huge expansion of power facilities "just in case" production should reach impossible heights and therefore require the facilities already planned through 1946 by governmental agencies.

TRANSPORTATION AND FUEL

There will be no fuel shortage except, perhaps, in the sense that "a bird in the hand is worth two in the bush". There is no shortage of mines, oil wells, or refineries, but we must make sure that transportation can get their products to consuming plants. Right now fuel oil is tight on the East coast for lack of tankers we gave England, and for lack of enough pipelines and tank cars to make up the deficit. And the day may come when coal cars and locomotives will be hard pressed to deliver the goods.

EQUIPMENT MAKERS KEEP PACE

How many turbines must be built, how quick? Here's the answer: The builders must keep all their facilities busy day and night—and boilers and auxiliaries must match the resulting kilowatts. With the big turbine shops "all out", the present annual building rate is about 2½ million kw steam and 1 million hydro.

SKILLED MANPOWER

In every power branch the truly practical men are realists whose work is grounded on power and mechanical experience. The engineers of the utilities, industrials, institutions, consulting firms and equipment manufacturers are clearly the key men behind the defense kilowatts and defense steam.

RESEARCH SHAPES FUTURE

The wise nation lives today's life and builds tomorrow's. More and more has organized scientific research become industry's prime investment in the future. Even in such critical days as these the defense byproducts of research justify all its cost and man hours.

IN MAPS AND TABLES the succeeding 16 pages show where additions have been made and will be made in all kinds of power plants. Here every power engineer with planning problems will find a starting point for his own blueprints.

Blueprint for Millions of Kilowatts

IT TOOK FORTY YEARS of unremitting labor to build America's national power plant—and now we have but five years to increase it by half. The immediate job of the power engineer is to bring this enormous program down to earth, break it into pieces small enough to understand and do something about.

The next fifteen pages are POWER's contribution to this objective. Here the reader will find as complete a picture as possible of the nation's power supply at the end of 1940, orders already placed and under construction, and the vast projected program of the Federal Power Commission.

Here are the broad lines of the utility program and of government power projects. First comes a map of existing stations over 30,000 kw, with planned capacity added in color—whether these expected additions are actually on order or projected as part of the FPC long-term program. Units on order are next listed in a tabulation of principal equipment characteristics to supplement the information on page 73, which merely shows the capacity and date of initial operation.

Industrial, municipal and institutional steam plants are listed as far as information is available. Because of the enormous volume of small orders, difficult to trace, and because so many installations in defense industries are held confidential, this list is far from complete, although helpful as an indicator of trends.

To supplement the steam-turbine information, hydroelectric projects of the power program are separately tabulated and supplemented by a map of Federal hydro installations now in operation or under construction.

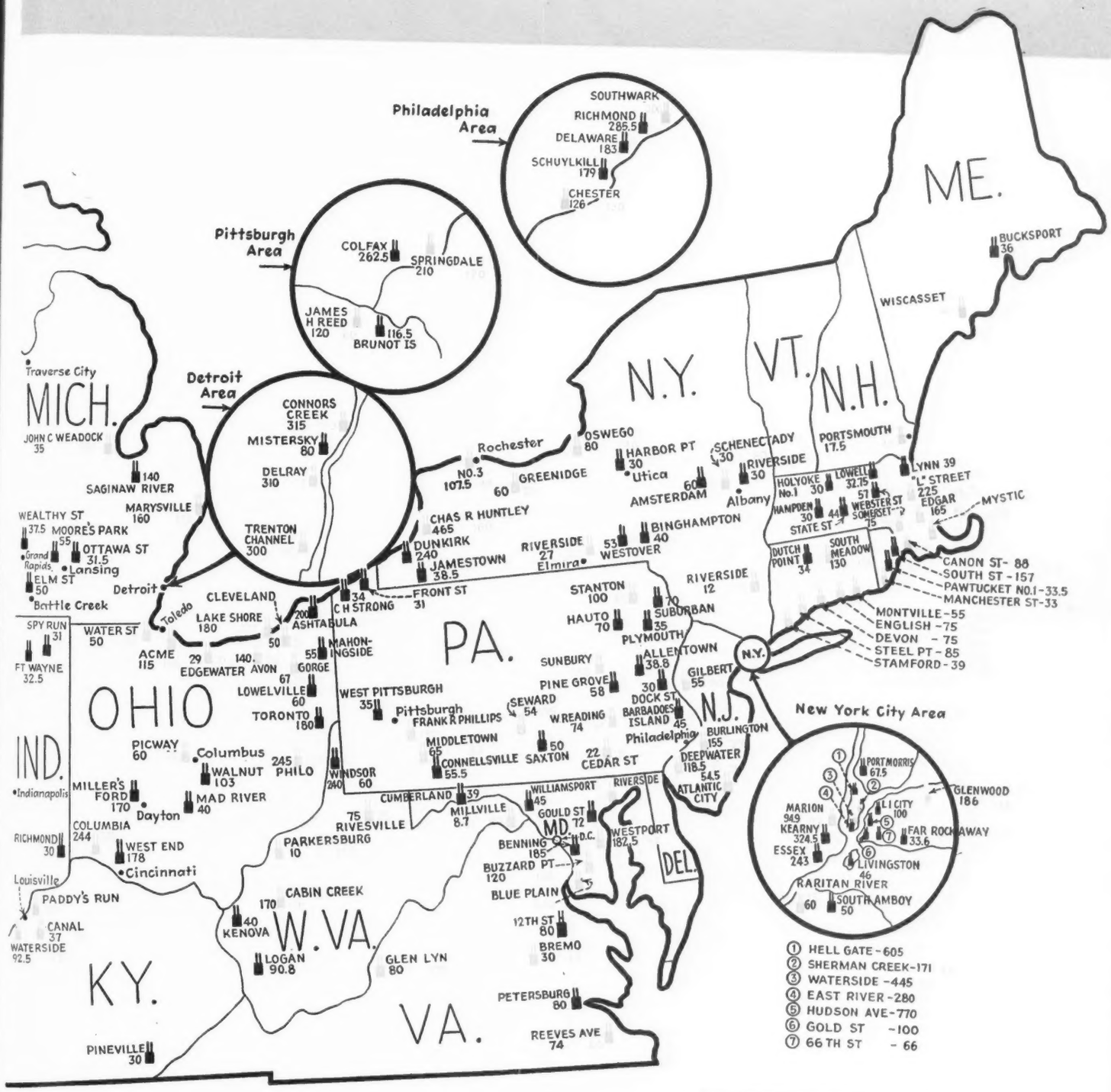
It must be remembered that the FPC program gives only a general indication of plant location and type of unit. It makes no attempt to dictate the actual plant and size of unit; these details are left for the engineers to work out as the schedule requires. As a top plan, indicating what parts of the country need priorities on power equipment, it represents regional requirements pretty well.

CENTRAL-STATION STEAM-

[SEE FOLLOWING TWO PAGES FOR OTHER SECTIONS OF U. S.]

POWER MAP

STEAM CENTRAL STATIONS OVER 30,000 KW



LEGEND

- Existing central station
- Existing central station with additions scheduled, or proposed plant
- 73 Installed kw as of December, 1940
- 25 Kw installed in 1941, on order, or projected

Kilowatt numbers represent thousands. Black numbers show total capacity as of December, 1940; red numbers show additional capacity installed, ordered and projected

CENTRAL-STATION STEAM-

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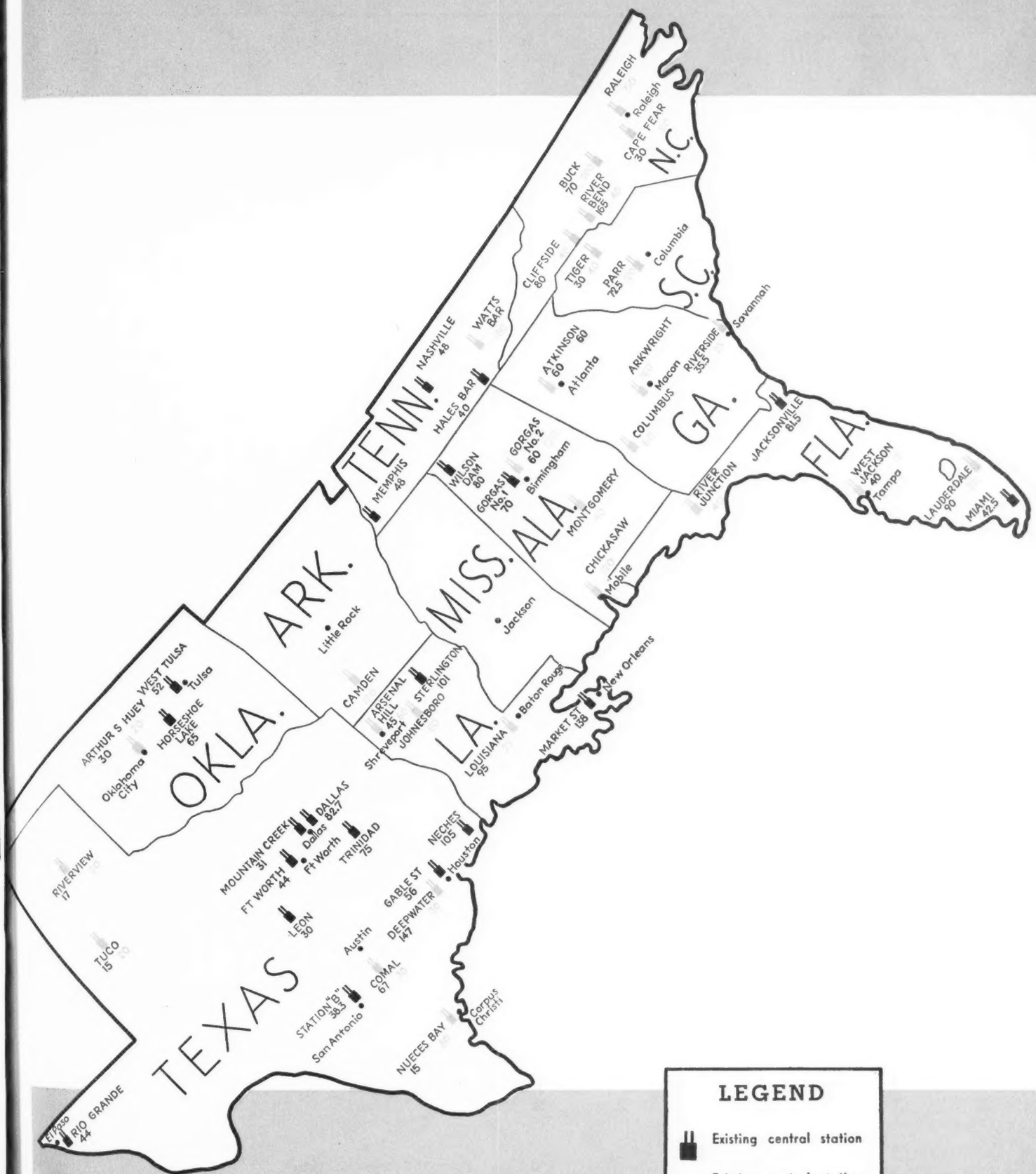
POWER MAP

STEAM CENTRAL STATIONS OVER 30,000 KW



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Typical Central Stations Installed or

Compiled by S A Tucker
Associate Editor

Company	Location	Plant Name	Consulting Engineers	First Operation, New Units	Nominal Pressure, Lb	Nominal Steam Temperature, F	BOILERS Number	BOILERS Capacity, Each, 1000 Lb per Hr	BOILERS Manufacturer	Furnace Volume, 1000 Cu Ft	Furnace Bottom	Economizer Surf per Boiler, 1000 Sq Ft	Air heater Surf per boiler, 1000 Sq Ft
1000 LB AND ABOVE													
Consolidated Edison Co, N. Y.	New York, N. Y.	Sherman Creek		1942	1625	950	1	925	CE	53	ST	32.5	285.2
Public Service Elec & Gas Co	Burlington, N. J.	Burlington		12-42	1475	950	2	550	BW	23.5	ST	11.5	99.4
Public Service Elec & Gas Co	Jersey City, N. J.	Marion		11-42									
Boston Edison Co	Everett, Mass.	Mystic	Jackson & Moreland	12-42	1400	910	1	430	CE		DB	14.06	61.0
Boston Edison Co	South Boston, Mass.	L Street	Jackson & Moreland	8-42	1400	910	1	500	CE	31.5	DB	16.43	63.7
Metropolitan Edison Co	West Reading, Pa.	West Reading		9-41	1400	900	2	275	CE	16.9	DB	8.36	40.4
Pacific Gas & Electric Co	San Francisco, Calif.	Oleum		1943	1400	950	3	200	BW		DB		
Appalachian Elec & Power Co	Cabin Creek, W. Va.	Cabin Creek	Am G & E Serv Corp	6-42	1375	950	4	450	FW	23.8	DB	16.8	23.2
Ohio Power Co	Philo, Ohio	Philo	Am G & E Serv Corp	1942	1375	950	2	450	BW	19.8	DB	10.0	66.0
Deepwater Light & Power Co	Deepwater, N. J.	Deepwater	Am G & E Serv Corp	1-42	1350	765	1	550	BW	48.5	DB	21.6	68.6
Penn Power & Light Co	Harrisburg, Pa.	Cedar	Ebasco Services	6-41	1325	930	2	185	CE	8.09	DB	11.26	7.7
Wisconsin Electric Power Co	Port Washington, Wis.	Port Washington	Wis. Elect Pwr Co	11-42	1325	850	1	690	CE	60.0	DB		121.0
San Antonio Public Serv Co	San Antonio, Tex.	Station B	United Lt & Pr Serv Co.	2-43	1325	900	1	275	BW	14.1	DB		41.7
Buffalo Niagara Elect Corp	Buffalo, N. Y.	Huntley		1942	1250	900	1	900	BW	37.7	ST	18.6	163.9
Commonwealth Edison Co	Chicago, Ill.	Fisk	Sargent & Lundy	10-43	1250	925	2	750	CE	48.0	ST	26.6	100.1
Commonwealth Edison Co	Chicago, Ill.	Fisk	Sargent & Lundy	11-42	1250	925	2	750	BW	46.0	ST	26.7	100.8
Monongahela-West Penn P S Co	Rivesville, W. Va.	Rivesville	Sanderson & Porter	10-42	1250	925	1	400	FW	23.8	DB	19.2	34.0
Philadelphia Electric Co	Chester, Pa.	Chester		1942	250	570	1	600	BW	27.0	ST	17.8	29.8
850 TO 999 LB													
Alabama Power Co	Chickasaw, Ala.	Chickasaw	C & S Corp	1942	950	900	1	400	CE		DB		45.1
Georgia Power Co	Macon, Ga.	Arkwright	C & S Corp	3-42	950	900	1	400	CE		DB		45.1
Georgia Power Co	Macon, Ga.	Arkwright	C & S Corp	6-43	950	900	1	400	BW	22.3	DB	15.9	77.1
Connecticut Light & Power Co	Devon, Conn.	Devon		1942	950	900	2	225	CE	12.4	DB		40.8
Duke Power Co	Spencer, N. C.	Buck	Duke Power Co	7-42	925	900	1	375	CE	19.3	DB		38.9
Southern Ind Gas & Elect Co	Evansville, Ind.	Ohio River	C & S Corp	9-42	900	900	1	225	RS	12.4	DB	5.5	34.0
Jersey Central Pwr & Lt Co	Sayreville, N. J.	Raritan River	Burns & Roe	1941	900	900	1	400	BW	15.4	ST	14.7	70.4
Jersey Central Pwr & Lt Co	Sayreville, N. J.	Raritan River	Burns & Roe	1943	900	900	1	400	BW	15.4	ST	14.7	70.4
Carolina Power & Light Co	Moncure, N. C.	Cape Fear	Ebasco Services	1942	900	905	2	300	RS		DB		
Consumers Power Co	Undetermined	Undetermined	C & S Corp	1943	875	900	1	550	FW		DB	38.0	55.3
Indianapolis Pwr & Lt Co	Indianapolis, Ind.	Harding St	Gibbs & Hill	1943									
Consumers Power Co	Bay City, Mich.	John C Weadock	C & S Corp	8-42	875	900	1	550	FW		DB	38.0	55.3
Tampa Electric Co	Tampa, Fla.	W Jackson St	Stone & Webster	8-42	860	830	1	160	BW	6.7	DB		17.2
Alabama Power Co	Gorgas, Ala.	Gorgas No. 2	C & S Corp	3-43	850	900	1	650					
Northern States Power Co	St. Paul, Minn.	High Bridge	P U Engrg & Serv	11-41	850	900	1	450	BW	37.5	DB	16.0	77.3
New Bedford Gas & Edison Co	New Bedford, Mass.	New Bedford	E M Gilbert Engrg Corp.	2-42	850	825	2	150	BW			7.7	
Tennessee Valley Authority	Watts Bar Dam, Tenn.	Watts Bar	Chas T Main	11-41	850	900	3	600	BW		ST	20.8	90.0
Consol Gas Elec Lt & Pr Co	Baltimore, Md.	Riverside		11-42	850	900	1	550	BW	28.95	DB	13.2	66.6
Duquesne Light Co	Wireton, Pa.	Frank R Phillips		4-42	850	900	2	500	FW	25.4	DB	15.1	51.6
Hartford Electric Light Co	Hartford, Conn.	South Meadow	Stone & Webster	9-42	850	900	1	450	BW	19.9	DB	18.4	65.2
Philadelphia Electric Co	Philadelphia, Pa.	Southwark		1943	850	900	2	850	BW	40.5	ST	10.1	492.0
Philadelphia Electric Co	Philadelphia, Pa.	Southwark		1943	850	900	2	850	BW	40.5	ST	10.1	492.0
Virginia Electric & Power Co	Norfolk, Va.	Reeves Avenue	Stone & Webster	10-41	850	875	1	450	CE		ST		
Detroit Edison Co	Marysville, Mich.	Marysville		12-42	815	900	3	440	CE	23.6	DB	12.0	83.6
650 TO 849 LB													
Ohio Edison Co	Akron, Ohio	Gorge	C & S Corp	10-42	800	850	1	450	BW		DB	15.	77.4
N.Y. State Electric & Gas Corp	Dresden, N. Y.	Greenidge			700	825	1	220	FW	12.2	DB	8.6	28.8
Virginia Public Service Co	Alexandria, Va.	Alexandria	Atl Ut Serv Corp	7-42	700	825	2	80	CE	3.6		6.0	
Potomac Electric Power Co	Washington, D. C.	Buzzard Point		1942	690	900	1	525	CE	25.0	ST	13.8	51.6
Interstate Power Co	Dubuque, Iowa	Dubuque		12-41	675	900	1	150	CE	9.8	DB		19.6
Wisconsin Public Service Corp		Bayside		7-42	675	900	1	310	BW		DB		
Rochester Gas & Elec Corp	Rochester, N. Y.	Rochester #3	E M Gilbert Engrg Corp.	1942	660	825	1	300	CE		DB	6.6	33.7
Cincinnati Gas & Elect Co	Cincinnati, Ohio	Columbia	Columbia Engrg Corp	7-42	650	900	2	350	BW	4.8	ST	15.98	34.8
Superior Water, Lt & Pwr Co	Superior, Wis.	Winslow	Ebasco Services	2-42	650	825	1	125	CE	6.1	DB		13.8
Kansas City Power & Light Co	Kansas City, Mo.	Grand Avenue	United Lt & Pr Serv Co.	7-43	650	950							
Louisville Gas & Electric Co	Louisville, Ky.	Canal	PU E & S Corp	11-41	650	900	1	312	CE	20.3	DB	7.8	56.5
Louisville Gas & Electric Co	Louisville, Ky.	Paddy's Run	PU E & S Corp	5-42	650	900	2	312	CE	20.3	DB	7.8	56.5
United Illuminating Co	Bridgeport, Conn.	Steel Point	Westcott & Mapes	10-43	650	860	2	150	BW	8.3	DB		14.2
400 TO 649 LB													
Iowa Elect Light & Power Co	Boone, Iowa	Boone	John W Drabelle	10-43	600	750	2	130	SB	7.4	DB		20.0
Mayaguez Lt, Pr & Ice Co	Mayaguez, P. R.	Plant No. 2		6-42	600	825	1	55	CE	1.5	DB		3.8
Interstate Power Co	Albert Lea, Minn.	Albert Lea	Sargent & Lundy	12-41	450	825	1	90	CE		DB		
Long Island Lighting Co	Glenwood Lndg, N. Y.	Glenwood	Burns & Roe	11-41	450	800	1	550	BW	39.9	DB	15.9	101.6
Porto Rico RR, L & Pwr Co	San Juan, P. R.	Santurce	Montreal Engrg Co	8-41	450	710	2	110	BW	3.4			7.8
Union Public Service Co	Canby, Minn.		R D Thomas & Assoc	12-41	450	750							
Central Ohio Lt & Pwr Co	Bluffton, Ohio	Woodcock	Sargent & Lundy	1-41	425	825	1	90	RS	5.4	DB		11.2
Columbus & South Ohio Elec Co	Columbus, Ohio	Pieway	United Lt & Pr Serv Co.	1-42	400	750							
Interstate Power Co	Clinton, Iowa	Clinton		8-41	400	825	1	45	RS	3.3	DB		4.2
Oklahoma Gas & Elect Co	Oklahoma City, Okla.	Arthur S Huey	PU E & S Corp	6-43	400	750							
BELOW 400 LB													
Central Power & Light Co	Corpus Christi, Texas.	Nueces Bay	Sargent & Lundy	3-42	390	835	1	175	BW				10.6
Central Power & Light Co	Corpus Christi, Texas.	Nueces Bay	Sargent & Lundy	10-42	390	835	1	175	BW				10.6
Public Service Co of Colo	Boulder, Colorado	Valmont		1941	350	750	2	300	BW	18.4	DB, ST		46.4
San Diego Gas & Electric Co	San Diego, Calif.	Station B		9-41	250	700	1	200	BW	8.2			16.3
Lake Superior District Power Co.	Ashland, Wis.	Bay Front	Middle West Serv Co.	9-41	225	550	1	120	RS	4.0		4.8	

A — Air cooling
Ab — Aluminum bronze
AC — Allis-Chalmers Mfg Co
Ad — Admiralty
BW — Babcock & Wilcox Co
C — Coal, bituminous
CA — Coal, anthracite
CE — Combustion Engineering Co
CP — Arsenical copper
D — Damper
DB — Dry bottom
DL — De Laval Steam Turbine Co
Du — Duplex
EC — Erie City Iron Works
EL — Elliott Co
FW — Foster Wheeler Corp
G — Gas
GE — General Electric Co
H — Hydrogen cooling
Hy — Hydraulic coupling
M — Motor drive
Ma — Magnetic coupling
2MP — Two motors per fan
MS — Moore Steam Turbine Corp

Under Construction Since July, 1940

Air heater Type	FD FANS		ID FANS		Firing	FUEL			FEED PUMPS		TURBINES						Generator Cooling	CONDENSER			Total Blr Capacity, Incl New Units, 1000 Lb	Total Gen Capacity, Incl New Units, 1000 Kw
	Drive	Air Volume Control	Drive	Gas Volume Control		Type	Heating Value, 1000 Btu per Lb	Ash-Fusion Temperature, F	Drive	Flow Control	Capacity, 1000 Kw	Speed, RPM	Manufacturer	Backpressure, Lb Abs	No. of Bleed Points	Bleed Press, Lb Abs		Surface 1000 Sq Ft	No. Water Passes	Tube Mat'l		
RE	T	S	T	S	PC	C	14.1	2500	T	S	50.0	3600	WE	215.0	1	415	H	....	..	...	2,815	221
RE	M	V	M	S, V	PC, O	O, C	18.4–14.2	2100+	M	Hy	100.9	3600	WE	0.5	5	322–10.2	H	55.0	1	Ad	2,825	225
...	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	50.0	3600	GE	0.5	2	28.4– 7.5	H	55.0	1	Ab	2,975	195
RE	M	V	M	.....	PC, O	O, C	18.5–14.9	2550	.....	....	50.0	3600	GE	0.5	4	188– 5	H	33.8	1	Ab	430	50
RE	M	V	M	S	PC, O	O, C	18.5–14.9	2550	2M, 3T	S	18.75	3600	GE	330.0	..	.....	A	....	..	...	2,878	246
RE	M	V	M	V	PC	C	13.84	.....	3T	S	20.0	3600	WE	280.0	..	.....	A	....	..	...	1,347	96
TU	M	V	M	V	O, G	O, G	.....	.....	.....	....	40.0	3600	GE	225.0	..	.....	H	22.0	1	...	1,200	80
RE	MT	V, D	MT	V, D	PC	C	12.9	2700	6M	....	2–85.0	3600	GE	0.5	5	495– 5.8	H	47.0	1	Ad	3,600	286
RE	MT	V, D	MT	V, D	PC	C	11.5	2000	3M	....	85.0	3600	GE	0.5	5	495– 5.8	H	52.5	1	CP	1,760	115
RE	MT	V	MT	V	PC	C	14.0	2480	2M	....	20.0	3600	GE	215.0	..	.....	H	....	..	...	3,450	138
TU	M	V	M	V	TG	CA	10.7	2500	2M, 1T	R	15.0	3600	GE	225.0	..	.....	A	....	..	...	.....	37
PL	2MP	S	2MP	S	PC	C	13.0	2250	2M, 1T	R	80.0	1800	AC	0.5	5	400	H	52.5	1	...	1,380	160
TU	2MP	V	2MP	V	G	G	1.0	.....	2M, 1T	S	20.0	3600	WE	1.0	4	199– 9.9	H	22.7	2	CP	822	56.5
TU	M	Ma	M	Ma	PC	C	13.7	2550	3M	Hy	80.0	1800	GE	0.5	6	.....	H	58.6	1	Ad	7,640	545
TU	M	V	M	V	PC	C	10.0	2350	3M, 1T	R	150.0	1800	WE	0.5	5	509– 6	H	90.0	1	...	3,750	473
TU	M	V	M	V	PC	C	10.0	2350	3M, 1T	R	147.0	1800	AC	0.5	5	480– 5.5	A	90.0	1	Ad	5,120	473
TU	M	V	M	S	PC	C	13.5	2100	M	R	35.0	3600	WE	0.75	4	280–10.2	H	30.0	2	Su	1,050	110
RE	M	Hy	M	Hy	PC	C	14.06	2400	T	S	80.0	1800	WE	0.5	3	66– 5.4	H	63.5	1	Ad	1,200	256
...	2MP	V	2MP	D	PC, C	O, C	12.0–13.5	2100+	2M	....	40.0	3600	WE	1.0	5	316– 9.2	H	26.9	2	...	800	80
TU	2MP	V	2MP	V	PC	C	14.0	2700	M	....	40.0	3600	WE	1.0	5	316– 9.2	H	31.3	2	...	800	80
TU	.....	.....	.....	.....	PC, G	C, G	14.0–13.5	2700	M	....	40.0	3600	GE	1.0	5	249	H	31.3	2	...	1,200	120
RE	M	V	M	Hy	PC	C	14.0	2400	2M	....	45.0	3600	WE	0.5	5	311– 5.6	H	30.0	..	...	.....	.....
RE	M	Hy	M	Hy	PC	C	14.3	2600	3M, 1T	....	40.0	3600	GE	0.75	4	201.6– 5.5	H	31.3	2	Ad	2,250	190
TU	M	Hy	M	V	PC	C	10.6	2100	M	....	20.0	3600	AC	1.0	5	235–23.7	H	18.3	2	...	970	72
TU	M	Ma	M	Ma	PC	C	14.4	2550	.....	....	.....	.....	.....	.....	..	.....	..	....	..	...	850	.....
TU	M	Ma	M	Ma	PC	C	14.4	2550	.....	....	25.0	3600	GE	315.0	..	.....	H	....	..	...	1,250	85
TU	M	D	M	D	PC	C	11.0	1950	4M, 1T	....	25.0	3600	WE	1.0	5	295–12	H	26.5	2	Ad	1,200	90
TU	.....	.....	.....	.....	PC	C	13.3	2300	.....	....	50.0	3600	GE	0.5	5	225– 5.95	H	43.0	2	...	.....	.....
...	.....	.....	.....	.....	.....	....	.....	.....	.....	....	37.5	3600	GE	0.75	4	164.3– 5.33	H	30.0	2	Ad	1,520	148
TU	M	V	M	Hy	PC	C	13.3	2300	M	....	50.0	3600	GE	0.5	5	225– 5.95	H	43.0	2	...	1,750	120
RE	M	V	M	V	O	O	18.1	.....	2M	S	15.0	3600	WE	1.0	4	.....	A	14.0	2	Ab	886	55
...	.....	.....	.....	.....	.....	....	.....	.....	.....	....	60.0	3600	GE	0.5	..	.....	H	....	..	...	1,450	120
TU	2M	Ma	2M	Ma	PC	C	11.2	1900	2M, 1T	S	50.0	3600	GE	0.75	4	200– 9	H	43.8	2	Ad	450	117
...	M	V	2MP	V	UF (388)	C	14.3	.....	3T	S	7.5	3600	GE	200.0	..	.....	A	....	..	...	1,750	96
RE	Du	V	Du	D	PC	C	13.5	2000	5M	R	3–60.0	1800	GE	1.0	4	243–10.4	A	40.0	1	Ad	1,800	180
RE	M	V	M	S, D	PC, O	C, O	14.1	2350	1M, 1DU	S, R	50.0	3600	GE	0.5	4	364–11	H	46.5	2	Ad	550	50
RE	M	Ma	M	Ma	PC	C	12.9	.....	1M, 2T	S, R	60.0	3600	WE	0.75	5	355– 5.2	H	43.6	1	Ad	1,000	60
RE	Du	D,Hy	M	D,Hy	PC, O	C, O	14.0–18.0	2750	1M, 1T	....	45.0	3600	GE	0.5	3	.....	H	36.0	2	Ad	1,760	170
RE	.....	.....	.....	.....	PC	C	14.0	2250	M	....	150.0	3600	WE	0.5	4	295– 6.4	H	77.0	1	Ad	3,400	150
RE	.....	.....	.....	.....	PC	C	14.0	2250	M	....	150.0	1800	WE	0.5	4	295– 6.4	H	77.0	1	Ad	3,400	300
RE	M	V	M	Hy	PC	C	14.4	2400	2M, 1T	S	40.0	3600	WE	0.75	3	201–10	H	30.0	1	Ab	1,600	114
RE	M	S, D	M	S, D	PC	C	13.5	2500	1M, 1T	S	75.0	1800	GE	0.5	4	224– 7.7	A	50.3	1	Ad	3,160	235
TU	.....	.....	.....	.....	PC	C	11.5	2400	3M	....	35.0	3600	WE	1.0	5	220– 6.5	H	32.6	2	...	1,394	102
TU	M	V	M	V	PC	C	13.9	2500	2M	R	20.0	3600	GE	14.5	3	122– 6.8	A	16.9	2	...	440	40
...	M	V	M	V	UF (202)	C	14.5	2358	2T	S	15.0	3600	WE	14.2	2	29.7– 8.8	A	12.0	2	Ad	348	43
RE	M	V	M	D	PC	C	14.3	2300	4M, 1T	S	50.0	1800	GE	0.5	4	202– 7	A	41.0	1	Ad	2,325	220
TU	2MP	V	2MP	Ma	PC	C	10.5	1950	M	R	.....	.....	.....	.....	..	.....	..	.....	..	...	498	38
RE	2MP	.....	2MP	Ma	PC	C	13.2	2500	1M, 1T	R	30.0	3600	AC	0.5	..	.....	H	....	2	...	570	50
TU	M	V	2MP	V	PC	C	13.6	2600	1M, 1T	R	25.0	3600	GE	14.5	3	.....	H	20.5	2	CP	.....	.....
TU	MT	V	MT	V	PC	C	13.5	2500	3M	....	65.0	1800	GE	0.5	4	170– 7	H	51.8	2	CP	2,700	256
TU	2MP	D	2MP	D	PC	C	14.2	2600	1M, 1T	R	12.5	3600	AC	0.5	3	130–11	A	10.9	1	Ad	160	14
...	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	35.0	3600	WE	0.75	6	380–10	H	....	..	...	1,425	142
RE	M	Ma	M	Ma	PC	C	11.3	1975	2M, 1T	R	25.0	3600	WE	0.75	4	144– 7.2	H	28.0	2	Ad	967	62
RE	M	Ma	M	Ma	PC	C	11.3	1975	2M, 1T	R	25.0	3600	WE	0.75	4	144– 7.2	H	28.0	2	Ad	624	50
RE	M	V	M	V	PC	C	14.2	2575	2M, 1T	S	25.0	3600	GE	0.5	4	265–12	H	27.2	2	Ad	1,534	135
RE	2MP	D	2MP	V	PC	C	8.9	1950	1M, 1T	S	7.5	3600	AC	0.5	4	287– 8.5	A	9.5	2	Ad	360	22
TU	M	D	M	D	O	O	18.5	.....	2M	R	5.0	3600	GE	1.0	3	125– 9	A	4.5	1	Ad	99	9
TU	M	.....	M	.....	O, G	O, G	1.0	.....	1M, 1T	R	7.5	3600	GE	0.5	3	119– 7.7	A	....	2	...	270	19
TU	M	V	M	Ma	PC, O	C, O	14.7	2500	.....	....	.....	.....	.....	.....	..	.....	..	....	..	...	1,650	170
TU	M	V	M	Hy	O	O	18.2	.....	1M, 1T	R	15.0	3600	GE	1.2	3	195– 2.0	A	6.8	2	Ab	385	25
...	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	5.0	3600	GE	.....	3	125– 5	A	6.3	2	Ad	120	10
TU	M	V	M	V	PC	C	13.8	2300	1M	R	7.5	3600	WE	0.5	3	118– 7.0	A	7.5	2	CP	210	17.5
...	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	30.0	3600	GE	0.75	3	110– 5.7	H	38.0	2	CP	900	.....
TU	M	V	M	Hy	PC	C	10.5	1950	.....	....	.....	.....	.....	.....	..	.....	..	.....	..	...	138	5.7
...	.....	.....	.....	.....	.....	....	.....	.....	M	R	20.0	3600	GE	1.0	3	.....	A	....	2	Ad	660	50
TU	M	V	M	V	G, O	G, O	1.1	.....	M	R	15.0	3600	GE	0.75	4	215.2–31.8	A	17.0	2	Ab	520	30
TU	M	V	M	V	G, O	G, O	1.1	.....	M	R	15.0	3600	WE	0.75	4	102– 8.4	A	17.0	2	Ab	520	45
TU	2MP	V	2MP	V	PC	C	9.2	2230	T	S	25.0	3600	GE	0.5	5	86– 2	A	31.0	2	...	1,420	95
TU	M	V	M	V	O, C	O, G	1.1	.....	.....	....	3.0	3600	GE	.....	..	.....	A	....	..	...	1,335	102
...	2MP	Hy	2MP	Hyd	UF (244)	C	13.8	2489	1M, 1T	R	.....	....	....	.....	..	.....	..	....	..	...	300	15

MT — One motor-one turbine per fan
MU — Munts metal
O — Oil
PC — Pulverised coal
PCO — Pulverised-coal and oil
PL — Plate
R — Regulator
RE — Regenerative
RS — Riley Stoker Corp
S — Speed control
SB — Springfield Boiler Co
SS — Spreader stoker
ST — Slag tap
Su — Superloy
T — Turbine drive
TU — Tube
TG — Traveling-grate stoker
UF — Underfeed stoker
UI — Union Iron Works
V — Vane control
WI — Wickes Boiler Co
WW — Wood waste
* — Also burns Tar

Typical Industrial Steam Plants Installed

Compiled by L N Rowley, *Associate Editor*

Company	Location	Consulting Engineers	First Operation, New Units	Nominal Pressure, Lb	Nominal Steam Temperature, F	BOILERS: Number	BOILERS: Capacity, Each, 1000 Lb per Hr	BOILERS: Manufacturer	Furnace Volume, 1000 Cu Ft	Furnace Bottom	Economizer Surface per Boiler, 1000 Sq Ft	Air-Heater Surface per Boiler, 1000 Sq Ft
600 LB AND ABOVE												
Columbia Chemical Div	Barberton, Ohio		12-41	900	750	1	150	BW	8.7	...	3.8	12.2
Aluminum Ore Co	Mobile, Ala	J G White Co	7-41	850	850	3	100	BW	6.7	...	...	14.9
Eastman Kodak Co	Rochester, N. Y.		12-41	825	750	1	200	BW	8.0	...	3.2	9.0
Winchester Rptg Arms Co	New Haven, Conn	A L Nelson	7-41	675	750	1	100	RS	5.2	DB	...	16.0
General Electric Co	Lynn, Mass		8-41	650	850	1	125	BW	...	...	...	....
			5-41	250	452	2	60	FW	2.4	...	...	....
			4-41	250	488	3	60	BW	...	...	...	....
Kellogg Co	Battle Creek, Mich	Sargent & Lundy	1-42	650	750	1	100	RS	6.6	DB	...	15.5
Phelps Dodge Corp	Morenci, Ariz	Wilbur Jurden	11-41	650	835	2	160	CE	9.6	...	...	22.0
						4	45.5	CE	7.4	...	...	....
Shell Oil Co, Inc	Wood River, Ill		1-42	650	750	1	125	RS	8.2	ST	...	16.5
Tri-State Power Co-op	Genoa, Wis	A Y Taylor & Co	5-41	650	850	2	40	RS	2.2	...	...	6.5
General Electric Co	Pittsfield, Mass		9-41	625	825	1	100	BW	4.9	DB	...	12.1
Millville Mfg Co	Millville, N. J.		1941	610	750	2	80	EM	4.3	DB	...	9.2
Carbide & Carbon Chem Corp	Texas City, Texas	Ford, Bacon & Davis	5-41	600	700	2	150	BW	5.4	...	...	....
Pennsylvania R R	Pittsburgh, Pa		2-42	600	589	2	40	EC	1.8	...	...	....
Celanese Corp	Narrows, Va		1-42	600	800	2	150	RS	8.8	DB	...	17.2
General Electric Co	Erie, Pa		....	600	850	1	125	BW	5.3	...	...	6.0
St. Mary's Kraft Corp	St. Mary's, Ga	G F Hardy	7-41	600	700	1	40	BW	3.2	ST	...	4.0
			7-41	600	700	1	60	BW	3.2	...	1.4	3.7
450 TO 599 LB												
W. Va. Pulp & Paper Co	Mechanicville, N. Y.		....	575	700	2	150	FW	15.1	...	8.5	4.4
E I Du Pont de Nemours	Millington, Tenn		11-40	550	700	6	90	CE	5.7	DB	...	14.6
E I Du Pont de Nemours	Charlestown, Ind		....	550	700	11	160	CE	11.8	DB	...	34.3
Salt River Valley Assn	Tempe, Arizona	F S Cummings	8-41	475	750	3	100	BW	...	...	...	8.6
Alton Box Board Co	Alton, Ill		7-41	450	750	..	...	....	...	...	...	....
Bendix-Westinghouse Co	Wilmerding, Pa		6-41	450	750	2	20	BW	...	...	...	....
Blandin Paper Co	Grand Rapids, Minn		1-42	450	675	1	100	BW	...	DB	...	....
Champion Paper & Fibre	Canton, N. C.		1941	450	700	1	70	CE	7.0	ST	...	....
Ecusta Paper Corp	Pisgah Forest, N. C.	J E Sirrine & Co	8-41	450	700	2	41.5	CE	...	...	...	....
Florida Pulp & Paper Co	Pensacola, Fla	Hardy S Ferguson	7-41	450	650	1	40	BW	...	ST	...	....
Fulton Bag & Cotton Mills	Atlanta, Ga		7-41	450	650	1	82	BW	...	...	...	....
			6-40	450	730	1	65	BW	2.4	DB	...	4.9
Gaylord Container Corp	Bogalusa, La	E H Barry	1-42	450	710	1	210	RS	9.0	DB	...	24.5
				450	710	1	150	RS	6.9	DB	...	21.0
				450	710	1	100	CE	5.5	...	...	....
International Paper Co	Corinth, N. Y.		1-42	450	750	1	100	BW	5.7	DB	...	11.4
James Lees & Sons Co	Bridgeport, Pa	H A Kuljian & Co	10-41	450	700	1	30	EM	2.0	...	0.8	....
Magnolia Pet. Co	Beaumont, Texas		7-41	450	673	1	260	CE	11.2	...	...	21.8
Minn. & Ontario Paper Co	International Falls, Minn		10-41	450	600	1	80	CE	...	DB	...	7.4
Monsanto Chemical Co	Nitro, W. Va		12-40	450†	...	1	40	RS	1.9	...	0.9	....
Penn. Salt Mfg Co	Wyandotte, Mich		11-41	450	700	1	200	BW	9.9	DB	...	25.6
Minn. Street Ry Co	Minneapolis, Minn		6-41	450	735	1	150	CE	8.2	...	...	16.4
J J Rogers Co	Au Sable Forks, N. Y.		7-41	450	600	1	50	EC	...	...	1.7	....
Rayonier, Inc	Hoquiam, Wash		12-40	...	...	..	...	...	...	...	...	....
Rayonier, Inc	Port Angeles, Wash		1-42	...	...	..	...	...	...	...	...	....
BELOW 400 LB												
General Electric Co	Bridgeport, Conn		12-41	425	750	1	100	BW	4.5	DB	...	10.7
F & M Schaefer Brg Co	Brooklyn, N. Y.	Fred Ophuls	5-41	425	650	1	75	BW	2.9	...	...	7.6
Crawford Clothes	Long Island City, N. Y.	Huxley Madeheim	2-41	400	700	1	16	BW	...	...	...	....
				150	...	1	16	TI	...	...	...	....
Crossett Paper Mills	Crossett, Ark		7-42	400	700	1	33.2	BW	2.9	ST	0.9	3.5
Algoma Steel Corp	Sault Ste. Marie, Ont	W E S Dyer	12-41	400	750	2	135	FW	8.9	DB	1.7	8.1
Harkness & Cowing Co	St. Bernard, Ohio		1941	400	...	1	10	BW	...	...	...	....
Masonite Corp	Laurel, Miss		8-41	400	750	2	75	RS	3.8	DB	...	6.9
Rhinelander Paper Co	Rhinelander, Wis		7-41	400	580	1	100	BW	3.0	...	6.7	....
Tennessee C, I, & R R	Fairfield, Ala		3-42	325	630	1	300	BW	16.5	DB	12.0	18.3
						1	200	BW	...	...	...	....
Carnegie-Illinois Steel Corp	Chicago, Ill		9-41	300	700	11	13.7	BW	...	...	...	....
Tubize Chatillon Corp	Rome, Ga	Lockwood-Greene	12-41	300*	650	1	45	BW	...	DB	...	8.1
Narragansett Brewing Co	Cranston, R. I		....	265	...	2	40	CE	2.3	DB	...	....
American Cyanamid Co	Wallingford, Conn		6-41	250	400	1	15	BW	...	...	...	....
Anaconda Wire & Cable Co	Sycamore Ill		11-41	250	400	1	6	BW	...	...	...	....
Bethlehem Steel Co	Quincy, Mass	United Engineers	11-40	250	400	3	60	CE	2.5	...	...	....
Granby Cons Mng, Smltg & Pwr Co	Princeton, B. C.		8-40	250	600	2	80	CE	1.8	DB	...	15.0
			8-40	250	600	1	40	....	...	...	...	....

ABBREVIATIONS AND GENERAL NOTES

UNDER BOILER MANUFACTURER
BW — Babcock & Wilcox Co
CE — Combustion Engineering Co
EC — Erie City Iron Works
EK — E Keeler Co
EM — Edge Moor Iron Works
FW — Foster Wheeler Co
RS — Riley Stoker Corp
TI — Titusville Iron Works Co

UNDER AIR-HEATER TYPE
PL — Plate
RE — Regenerative
TU — Tube

UNDER FAN DRIVE
E — Engine
M — 1 Motor per fan
2M — 2 Motors per fan
T — 1 Turbine per fan
1M,1T — 1 Motor, 1 turbine per fan
*M** — Single motor or turbine driving both forced- and induced-draft fans

UNDER AIR-VOLUME CONTROL AND GAS-VOLUME CONTROL
D — Damper
Hy — Hydraulic coupling
Ma — Magnetic coupling
S — Variable-speed driver
V — Vane

UNDER FIRING AND FUEL TYPE
B — Bark and bark-burning grate or stoker
BFG — Blast-furnace gas
C — Bituminous coal
CA — Anthracite coal
CG — Chain-grate stoker
Cb — Coke breeze
Ck — Coke
G — Natural gas
L — Black liquor
La — Lampblack, handfired
O — Oil
PC — Pulverized Coal
PCk — Petroleum coke
SS — Spreader stoker
TG — Traveling-grate stoker
UF — Underfeed stoker
WH — Waste heat
WW — Wood waste or hogged fuel
Numbers in parenthesis equal stoker grate area in sq ft, projected

or Under Construction Since July, 1940

Air-Heater Type	FD FANS: Drive	FD FANS: Air-Volume Control	ID FANS: Drive	ID FANS: Gas-Volume Control	Firing	FUEL: Type	FUEL: Heating Value, 1000 Btu per Lb or per Cu Ft	FUEL: Ash-Fusion Temperature, F	FEED PUMPS: Drive	FEED PUMPS: Flow Control	TURBINES: Capacity, 1000 Kw	TURBINES: Speed, Rpm	TURBINES: Manufacturer	TURBINES: Backpressure, Lb Abs	TURBINES: Number of Bleed Points	TURBINES: Bleed Press., Lb Abs	Generator Cooling	CONDENSER: Surface, 1000 Sq Ft	CONDENSER: Number of Water Passes	CONDENSER: Tube Material	Total Blr Capacity, Incl. New Units, 1000 Lb per Hr	Total Gen Capacity, Incl. New Units, 1000 Kw
TU	2M	V	M	Hy	UF (403)	C	12.3	2100	T	S	10.0	3600	WE	15	1	140	A	...	..	...	1250	32.5
TU	M	Hy	M	Hy	PC, O, G	C, O, G	....	....	2T	....	7.5	3600	GE	110	..	.....	A	...	..	...	300	15
											7.5	3600	GE	110	..	.....	A					
TU	T	S	T	S	UF (422)	C	13.6	....	.....	....	5.0‡	3600	GE	20	2	275–150	A	...	..	...	1130	26
TU	M	S, V	M	S, D	PC	C	14.8	....	M	R	5.0	3600	GE	5	2	150—50	A	...	..	...	400	15
TU	M	D	M	D	O	O	18.6	....	2T	S, R	....	....	...	...	..	.....	..	...	..	...	836	31
...	1M, 1T	S, D	T	D	O	O	18.6	....	2T	S, R	....	....	...	...	..	.....	..	...	..	...		
...	T	S	T	S, D	O	O	18.6	....	2M, 1T	S	....	....	...	...	..	.....	..	...	..	...		
PL	M	V	M	V	PC	C	13.0	2500	2T	R	3.0	3600	GE	45	1	140	A	...	..	...	225	5
RE	M	D, U	M	D	G, O	G, O	1.1	....	2M, 2T	R	12.5	3600	GE	1	3	119–8	A	B	2	CP	502	45
...	.....	.....	.....	.....	WH	WH	.....	.....														
TU	1M, 1T	S	1M, 1T	S	PC,O,PCk	C,O,PCk	11.0	2100	T	S	....	....	...	...	..	.....	..	...	..	...	980	....
TU	M	V	M	D	PC	C	11.0	....	2M,1T	R	4.3	3600	M	0.7	3	190–12	A	3.1	1	Ad	80	8.6
TU	M	S, D	M	S, D	PC, O	C, O	14.3	2500	.....	.....	7.5	3600	GE	1	2	205–18	A	8.0	2	Mu	380	21
TU	M	V	M	V	PC, O	C, O	13.9	2100	1M,1T	....	....	....	...	...	..	.....	..	...	..	...	....	....
...	T	D	T	D	G, O	G, O	1.1	....	2T	S	7.0	3600	GE	85	..	.....	A	...	..	...	300	7
...	M	D	.....	....	UF (127)	C	12.9	2320	2T	S	0.7	3600	WE	165	..	.....	A	...	..	...	120	2.3
RE	M	S, V	M	S, V	PC	C	14.5	2300	1M, 1T	S	12.0	3600	GE	0.7	2	165–65	A	7.4	2	Ad	450	12
TU	2M	S, D	2M	S, D	UF (283)	C	13.5	2600	1M, 1T	R	....	....	...	...	..	.....	..	...	..	...	...	....
TU	M	D	M	D	L	L	...	....	1M, 1T	R	3.0	3600	GE	1	1	45	A	3.0	2	Br	100	3.4
TU	M	D	M	D	O, B	O, B	18.0	....														
PL	M	D	1M, 1T	S, D	PC	CA	11.8	3000	3T	R	5.0	3600	WE	1	2	160–30	A	...	2	Ad	800	10
TU	T*	S, V	T*	S, V	PC	C	11.4	....	5T	S	15.0**	3600	GE	...	..	.....	A	2.1	2	...	540	15
TU	T	V	T	S	PC	C	11.4	2000	8T	R	55.0**	....	WE	1.2	2	150–50	A	4.4	2	...	1760	55
TU	M	S, D	M	S, D	O, G	O, G	18.0	....	2M, 1T	R	7.5	3600	GE	1	3	.....	A	9.0	2	CP	300	28
...	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	1.5	3600	WE	54	1	175	A	...	..	...	250	5.5
...	1M, 1T	V	2M	D	UF	C	13.5	2400	1M, 1T	R	0.5	3600	WE	25	1	100	A	...	..	...	40	0.5
...	M	D, Ma	M	D, Ma	PC	C	14.2	2700	1M, 1T	R	4.0	3600	AC	...	1	25	A	3.0	2	...	250	10
RE	M	Hy	M	Hy	L	L	6.5	....	.....	....	7.5	3600	GE	1	1	44	A	8.0	2	Ad	915	30
...	M	Hy	.....	....	UF (138)	C	14.3	2620	1M, 1T	R	4.0	3600	GE	1	1	90	A	4.0	2	Ad	138	6
RE	1M, 1T	D	2M	D	L	L	....	....	1M, 1T	S, R	3.5	3600	WE	1	2	150–50	A	2.5	2	Mu	122	3.5
RE	1M, 1T	D	2M	D	G, O	G, O	1.0	....														
TU	M	S, D	M	S, D	PC	C	13.6	2400	2M, 1T	S	1.5	3600	GE	0.7	1	30	A	...	..	...	135	6.5
TU	2M	V	2M	V	G, O	G, O	....	....	2M, 2T	S	7.5	3600	WE	1	1	165	A	...	..	...	1100	25
TU	2M	V	2M	V	B	B																
...	2M	V	2M	V	L	L																
TU	M	D	M	D	PC	C	13.9	2400	1M, 1T	S	2.5	2400	GE	130	..	.....	A	...	..	...	330	5
...	M	D	M	D	UF (108)	C	13.5	....	2T	R	....	....	...	...	..	.....	..	...	..	...	60	....
RE	T	D	T	D	O, G	O, G	18.5	....	.....	....	....	....	...	...	..	.....	..	...	..	...	1060	25
TU	2M	D	2M	Hy, D	PC	C	14.0	2550	M	R	7.5	3600	GE	0.5	2	145–45	A	8.5	1	...	500	20
...	.....	.....	T	S, D	G	G	1.1	....	T	S	....	....	...	...	..	.....	..	...	..	...	65	....
TU	M	V, D	M	D	PC	C	13.3	2200	2M	R	6.0	3600	GE	1	2	150–3	A	6.0	2	Mu	620	23
TU	1M, 1T	D, Ma	1M, 1T	D, Ma	PC, G, O	C, O, G	14.2	2500	T	R	....	....	...	...	..	.....	..	...	..	...	900	....
...	1M, 1T	V	1M, 1T	D	TG (190)	CA	12.5	3000	1M, 1T	R	1.5	3600	GE	20	1	120	A	...	..	...	90	2.8
...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.0	3600	GE	50	..	.....	A	...	..	...	10	....
...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.0	3600	GE	65	..	.....	A	...	..	...	300	13
TU	M	S, D	M	S, D	PC	C	14.0	2500	M	....	....	....	...	...	..	.....	..	...	..	...	420	19
TU	1M, 1T	S	1M, 1T	S	O	O	18.4	....	T	S	0.8	3600	TE	50	..	.....	..	...	..	...	†75	2
...	.....	.....	M	D	O	O	....	....	M	....	0.2	4000	MI	125	..	.....	..	...	..	...	32	0.4
...	.....	.....	M	D	O	O	....	....	Du	R	0.2	4000	MI	19								
TU	M	D	T	D	G, L	G, L	.....	.....	.....	....	4.0	3600	WE	55	1	140	A	...	..	...	285	7.5
TU	M	V	M	S	PC, BFG	PC,BFG	14.0	2400	1M, 1T	R	1.0	3600	WE	160	..	.....	A	...	..	...	404	....
...	M	V	.....	....	SS (36)	C	....	....	2 Du	R	....	....	...	...	..	.....	..	...	..	...	10	....
TU	M	S, D	M	S, D	G	G	1.0	....	2M, 1T	R	5.6	3600	GE	1	2	153–34	A	5.9	2	CP	475	12
											5.6	3600	GE	1	2	153–34	A	5.9	2	CP		
											1.0	3600	GE	1	2	153–34	A	2.6	2	CP		
...	M	D	2M	D	UF (208)	C	14.2	2700	.....	....	4.0	3600	WE	...	1	10	A	2.9	8	Ad	400	10
TU	T	D	T	D	PC	C	12.2	2300	2T	S	20.0	1800	GE	1.2	..	.....	A	23.8	2	Ad	1350	60
TU	T	D	T	D	BFG	BFG	0.1	....														
...	.....	.....	T	....	.....	WH	.....	.....	1M, 2T	S, R	....	....	...	...	..	.....	..	...	..	...	1505	95.4
TU	M	V	M	D	PC	C	13.6	2300	.....	....	.....	.....	.....	.....	..	.....	..	...	..	...	315	8.8
...	1M, 1T	D	.....	....	PC, O	C, O	14.3	2400	1M, 1T	R	0.8	4500	TE	20	..	.....	A	1.1	3	Ad	80	1.4
...	M	D	.....	....	UF	C	....	....	2Du	S	....	....	...	...	..	.....	..	...	..	...	15	....
...	M	D	.....	....	TG (50)	C	....	....	2Du	S	....	....	...	...	..	.....	..	...	..	...	18	....
...	M	D	.....	....	O	O	18.5	....	2T, 3Du	R	....	....	...	...	..	.....	..	...	..	...	180	....
PL	M	V, Hy	M	V, Hy	PC	C	7.6	2100	3T	S, R	10.0	1800	AC	...	2	60–20	A	10.0	2	Ad	200	17.5
...	M	V, Hy	M	V, Hy	TG (195)	C	7.6	2100														

UNDER FEED-PUMP DRIVE
- *M* — 1 Motor-driven pump
- *2M* — 2 Motor-driven pumps, etc
- *T* — 1 Turbine-driven pump
- *2T* — 2 Turbine-driven pumps, etc
- *Du* — 1 Duplex reciprocating steam pump
- *2Du* — 2 Duplex pumps, etc
- *Si* — 1 Simplex reciprocating steam pump
- *2Si* — 2 Simplex pumps, etc

UNDER FEED-PUMP FLOW CONTROL
- *Hy* — Hydraulic coupling
- *Ma* — Magnetic coupling
- *R* — Pump regulator
- *S* — Variable-speed driver

UNDER TURBINE MANUFACTURER
- *AC* — Allis-Chalmers Mfg Co
- *EL* — Elliott Co
- *GE* — General Electric Co
- *M* — Moore Steam Turbine Co
- *MI* — Murray Iron Works Co
- *TE* — Terry Steam Turbine Co
- *WE* — Westinghouse Electric & Mfg Co

UNDER GENERATOR COOLING
- *A* — Air
- *H* — Hydrogen

UNDER CONDENSER-TUBE MATERIAL
- *Ad* — Admiralty
- *Br* — Aluminum Bronse
- *CP* — Arsenical Copper
- *Mu* — Munts Metal

GENERAL NOTES:
- † — Now operating at 125 lb
- * — Designed for future operation at higher pressure
- ** — Total capacity in turbines; individual data not available
- ‡ — Mixed-pressure turbine
- *Italics* — Under turbine capacity, indicates engine-generator

Typical Industrial Steam Plants Installed

Compiled by L N Rowley, *Associate Editor*

Company	Location	Consulting Engineers	First Operation, New Units	Nominal Pressure, Lb.	Nominal Steam Temperature, F	BOILERS: Number	BOILERS: Capacity, Each, 1000 Lb per Hr	BOILERS: Manufacturer	Furnace Volume, 1000 Cu Ft	Furnace Bottom	Economizer Surface per Boiler, 1000 Sq Ft	Air-Heater Surface per Boiler, 1000 Sq Ft
ABOVE 200 LB												
Hamman Exploration Co	Bay City, Texas		9–40	250	400	2	26	CE	...	...	...	....
Kohrs Cold Storage Co	Davenport, Iowa	H C Carroll	10–41	250	400	1	25	BW	1.2	...	...	....
Peninsula Plywood Corp	Port Angeles, Wash.		10–41	250	400	2	35	RS	...	DB	1.3	....
Rock Hill Prtng & Finishing Co	Rock Hill, S. C.	Lockwood-Greene	7–41	250	400	1	150	CE	...	DB	...	13.1
Jos E Seagram & Sons	Relay, Md.		....	250	406	1	30	CE	...	...	...	....
Republic Steel Corp	Birmingham, Ala		9–41	205	515	1	80	EC	6.5	...	...	....
Aluminum Co of Canada	Arvida, Que		3–41	200	388	2	131	CE	14.2	DB	...	10.4
Aluminum Ore Co	Rosiclaire, Ill.		10–41	200	388	1	30	BW	...	...	...	....
American Hoist & Derrick Co	St. Paul, Minn.	A L Sanford	11–41	200	440	1	40	RS	2.9	DB	0.9	....
American Rolling Mill Co	Butler, Pa.		9–41	200	480	1	40	BW	2.0	...	...	....
Canadian Industries, Ltd	Shawinigan Falls, Canada		9–41	200	388	3	25	FW	1.0	...	1.2	....
Cliffs Dow Chemical Co	Marquette, Mich.	Stone & Webster	6–41	200*	510	2	65	RS	4.4	DB	...	5.5
Crouse-Hinds Co	Syracuse, N. Y.	C R Acheson	9–41	200	388	1	60	BW	2.2	DB	...	3.9
J Ford & Co, Ltd	Port Neuf Station, Que.		4–41	200	388	1	15	FW	...	...	...	....
General Electric Co	Fort Wayne, Ind.		10–41	200	600	1	50	BW	1.9	...	...	....
Lehigh Portland Cement Co	Fordwick, Va.		....	200	435	2	43	BW	...	...	7.5	....
Malagash Salt Co, Ltd	Malagash, N. S.	S J Montgomery	9–41	200	523	2	18	FW	0.6	...	...	....
Mica Insulator Co	Schenectady, N. Y.	C R Acheson	11–41	200	388	1	35	BW	1.0	...	...	....
Papec Machine Co	Shortsville, N. Y.	J L Graham	10–41	200	482	1	13	RS	...	...	...	....
Puget Sound Pulp & Timber Co	Bellingham, Wash.	H D Cavin	3–41	200	477	1	70	BW	0.5	...	...	6.9
150–199 LB												
Gardner-Richardson Co	Middletown, Ohio		8–40	185	532	..	...	...	...	...	...	....
Whiting-Plover Paper Co	Stevens Point, Wis.	J V Eduskuty	12–41	180*	480	1	40	BW	2.3	...	...	....
Indianapolis Water Co	Indianapolis, Ind.		6–41	180	475	1	17	BW	0.9	...	...	....
Curtiss-Wright Corp	Robertson, Mo.	Albert Kahn	10–41	175	...	3	65	RS	3.5	...	...	5.5
						1	25	RS	0.6	...	0.5	....
Acme Steel Co	Riverdale, Ill.	C M Garland & Co	8–41	175	378	2	65	CE	2.4	...	2.4	....
Curtiss-Wright	Buffalo, N. Y.	Albert Kahn	7–41	175	378	3	75	RS	3.5	DB	...	5.5
			7–41	175	378	1	25	....	...	...	...	....
Eastman Kodak Co	Rochester, N. Y.		8–41	175	378	2	28	EK	1.0	...	...	....
Flint & Walling Mfg Co	Kendallville, Ind.	R W Noland	4–41	175	378	3	20	BW	2.5	...	...	....
Union Oil Co of Calif	Wilmington, Calif.	C C Moore & Co	4–41	165	373	1	35	BW	3.8	...	...	....
Nappanee Utilities Co	Nappanee, Ind.	Larimore & Douglass	9–41	160*	370	4	6	EC	...	...	...	....
Buffalo-Ankerite Gold Mines	South Porcupine, Ont.		12–40	160	370	1	6	FW	...	...	...	....
Geo A Hormel & Co	Austin, Minn.		.....	160	520	...	...	...	...	...	...	....
Griscom-Russell Co	Massillon, Ohio		9–41	160	370	1	33	CE	0.9	...	...	....
The Mead Corp	Sylva, N. C.	J B Gough	8–41	160	370	2	22	RS	0.6	...	0.5	....
Eastman Kodak Co	Chicago, Ill.		9–40	160	370	1	40	BW	1.5	...	...	....
Ryegate Paper Co	Ryegate, Vt.	E H Barry	3–41	160	370	1	20	RS	0.8	...	0.5	2.5
Standard Products Co	Port Clinton, Ohio		5–41	160	370	1	20	BW	...	...	...	....
Wolverine Shoe & Tanning Corp	Rockford, Mich.		....	160	370	..	....	...	...	...	...	....
Aluminum Co of America	Massena, N. Y.		10–41	150	366	1	100	BW	5.3	...	1.8	....
General Motors Corp	Kansas City, Mo.		11–41	150	366	1	100	EC	5.6	...	...	....
Dodge Forge Div	Detroit, Mich.	Met Device Corp	11–41	150	366	1	60	BW	...	DB	...	4.2
Citizens Gas & Coke Utility	Indianapolis, Ind.	Koppers Co	2–41	150	366	1	50	CE	...	...	...	....
Great Western Div	Pittsburg, Calif.		5–41	150	366	1	60	BW	2.4	...	...	....
Honolulu Gas Co, Ltd	Honolulu, T. H.		12–41	150	366	2	20	CE	...	...	...	....
Lever Bros Co	Baltimore, Md.	Stone & Webster	1–42	150	366	1	100	CE	4.5	...	...	....
Long-Bell Lumber Co	Weed, Calif.	McManama & Co	10–41	150	366	1	68	CE	...	...	...	....
George S Mepham Corp	East St. Louis, Ill.	Baumes Engrg Co	3–41	150	366	1	40	BW	...	...	...	....
			3–41	150	366	1	10	...	...	...	...	....
W S Merrill Co	Reading, Ohio		....	150	366	2	10	BW	...	...	...	....
Pennsylvania Salt Mfg Co	Portland, Ore.		9–41	150	366	1	12	RS	...	...	...	....
Smith Paper, Inc	Lee, Mass.	R Q Packard	11–40	150	366	2	10	RS	0.8	...	0.5	....
Tileston & Hollingsworth Co	Hyde Park, Mass.	Chas T Main	....	150*	410	1	25	BW	1.0	...	...	....
Union Bleachery	Greenville, S. C.	J E Sirrine & Co	9–41	150	366	1	50	BW	...	...	...	....
U. S. Coal & Coke Co	Gary, W. Va.		8–41	150	446	3	45	CE	...	DB	...	....
BELOW 150 LB												
Met Utilities District	Omaha, Neb.		12–41	140	361	1	45	EC	2.2	...	...	....
			12–41	140	361	1	45	EC	2.2	...	...	....
Warner & Swasey Co	Cleveland, Ohio	J P Jones	9–41	140	...	2	33	BW	1.1	...	...	....
Wyman-Gordon Co	Worcester, Mass.		11–41	135	358	2	70	BW	3.0	...	...	....
The Texas Co	Craig, Colo.		11–41	125	353	1	10	CE	0.7	...	...	....
Dougherty Refinery	Petrolia, Pa.		11–41	125	353	1	65	BW	2.6	DB	...	....
McLaurin Jones Co	Ware, Mass.	F J Sill	2–41	125	353	1	10	RS	...	...	...	....
Washington Gas Light	Washington, D. C.	United Engineers	12–41	125	353	2	50	BW	2.2	DB	...	3.1
The Texas Co	Port Neches, Texas		10–41	125	353	1	60	EC	3.2	...	...	....
Tubular Rivet & Stud Co	Wollaston, Mass.		....	125	353	1	18	BW	0.4	...	...	....
Landers Corp	Toledo, Ohio	Froehlich & Emery	1–41	120	350	2	9	BW	...	...	...	....
Fitzgerald Bros Brewing Co	Troy, N. Y.		9–41	100	338	2	18	BW	0.7	...	...	....
Pepsi-Cola Co	Long Island City, N. Y.	Dan Gutleben	1941	100	388	2	25	RS	1.0	...	0.6	....
Atlantic Wire Co	Branford, Conn.		9–41	...	...	..	....	...	...	...	...	....

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SS — Spreader stoker
TG — Traveling-grate stoker
UF — Underfeed stoker
WH — Waste heat
WW — Wood waste or hogged fuel

Numbers in parentheses equal stoker grate area in sq ft, projected

or Under Construction Since July, 1940

Air-Heater Type	FD FANS: Drive	FD FANS: Air-Volume Control	ID FANS: Drive	ID FANS: Gas-Volume Control	Firing	FUEL: Type	FUEL: Heating Value 1000 Btu per Lb or per Cu Ft	FUEL: Ash-Fusion Temperature, F	FEED PUMPS: Drive	FEED PUMPS: Flow Control	TURBINES: Capacity, 1000 Kw	TURBINES: Speed, Rpm	TURBINES: Manufacturer	TURBINES: Backpressure, Lb Abs	TURBINES: Number of Bleed Points	TURBINES: Bleed Press, Lb Abs	Generator Cooling	CONDENSER: Surface, 1000 Sq Ft	CONDENSER: Number of Water Passes	CONDENSER: Tube Material	Total Blr Capacity, Incl New Units, 1000 Lb per Hr	Total Gen Capacity, Incl New Units, 1000 Kw
...	.....	....	1M, 1T	....	G	G	1.1	....	2Du	R	....	....	...	..	..	.....	..	...	..	...	40	....
...	E	D	.....	....	SS (93)	C	10.5	1900	.....	....	....	....	...	..	..	.....	..	...	..	...	75	0.3
...	.....	....	.....	....	WW (232)	WW	9.0	....	1M, 1T	S, R	....	....	...	..	..	.....	..	...	..	...	70	....
RE	T	S	T	S, D	PC	C	13.8	2200	3M, 1T	R	3.5	3600	M	30	..	.....	A	...	..	...	400	3.5
...	M	V	.....	....	SS (85)	C	13.9	2600	T	R	....	....	...	..	..	.....	..	...	..	...	140	C.2
...	T	S	T	D	BFG	BFG	....	....	.....	....	....	....	...	..	..	.....	..	...	..	...	350	....
PL	M	V	1M, 1T	S, V, D	PC	C	13.3	1950	4M	R	....	....	...	..	..	.....	..	...	..	...	352	....
...	M	D	.....	....	TG	C	12.0	.....	2Du	R	....	....	...	..	..	.....	..	...	..	...	64	1.1
...	M	....	M	....	PC	C	13.8	2300	1M, 1T	....	....	....	...	..	..	.....	..	...	..	...	40	....
...	T	D	1M, 1T	....	UF (108)	C	13.5	2250	1M, 1T	R	....	....	...	..	..	.....	..	...	..	...	146	....
...	M	D	M	D	UF (77)	C	13.3	2100	1M, 1T	R	....	....	...	..	..	.....	..	...	..	...	75	....
TU	T	S	T	S	PC	C, WW	13.5	2200	2T	S	....	....	...	..	..	.....	..	...	..	...	130	1.0
TU	M	V	M	D	PC	C	14.4	2500	1M, 1T	R	....	....	...	..	..	.....	..	...	..	...	90	....
...	M	D	.....	....	SS (42)	C	13.5	....	1M, 1Du	R	....	....	...	..	..	.....	..	...	..	...	15	....
...	2M	V	.....	....	UF (128)	C	12.5	2300	1M, 1T	R	.....	.....	...	..	..	.....	..	...	..	...	...	....
...	.....	....	M	S, D	WH	.....	....	....	1M, 1T	R	3.5	3600	GE	1	2	90–30	A	5.9	2	Ad	86	6.5
...	M	D	M	D	SS (48)	C	12.0	2050	2Du	S	0.6 0.1	3600 3600	GE GE	1 20	1 ..	10	A ..	1.5 ...	2 ..	Mu ...	36	0.8
TU	M	Hy	M	Hy	SS, O	C, O	14.0	2100	2Du	R	....	....	...	..	..	.....	..	...	..	...	70	....
...	2M	D	M	D	UF (45)	C	....	....	2Du	R	....	....	...	..	..	.....	..	...	..	...	26	3.0
TU	1M, 1T	S, D	1M, 1T	S, D	WW (160)	WW, O	....	....	2T	S	....	....	...	..	..	.....	..	...	..	...	280	....
...	.....	....	.....	....	.....	.....	....	....	.....	....	1.5	3600	WE	45	..	.....	A	...	..	...	....	3.5
...	M	Ma	Mo	Ma	UF (151)	CA	13.9	2460	M	R	0.5	3600	GE	..	1	12	A	1.4	2	Br	32	1.0
...	T	D	.....	....	TG (81)	C	11.0	2150	3Du	R	....	....	...	..	..	.....	..	...	..	...	50	....
TU	1M, 1T	D	1M, 1T	D	PC, O	C, O	10.5	2000	2M, 1T	R	....	....	...	...	..	....	..	...	..	...	....	....
...	1M, 1T	D	1M, 1T	D	TG (81)	C	10.5	2000														
...	T	D	T	D	TG (210)	C	11.5	2000	T	R	....	....	...	..	..	.....	..	...	..	...	250	....
TU	1M, 1T	D	1M, 1T	D	PC, O	C, O	12.8	2160	2M, 1T	R	....	....	...	..	..	.....	..	...	..	...	250	....
...	.....	....	.....	....	TG (84)	C	12.8	2160														
...	1M, 1T	D	.....	....	UF (65)	C	13.6	....	2Du	R	.....	.....	...	...	..	.....	..	...	..	...	56	....
...	M	D	.....	....	SS (55)	C, WW	....	....	2Du	R	0.5E	100	AC	25	..	.....	A	...	..	...	60	0.5
...	.....	....	.....	....	O, G	O, G	....	....	1M, 1T, 1Du	S, R	....	....	...	..	..	.....	..	...	..	...	138	....
...	M	D	.....	....	SS(45)	C	11.5	2250	3Si	S, R	1.25	3600	WE	1	1	35	A	2.2	2	Mu	25	3.3
...	M	....	.....	....	SS (56)	C	14.3	3000	2Du	....	.....	.....	...	..	..	.....	..	...	..	...	6	....
...	....	....	.....	....	.....	.....	....	....	....	....	1.0	4250	TE	2	1	85	A	2.4	2	CP	190	2.2
...	M	D	.....	....	SS (81)	C	11.5	2100	2Du	R	....	....	...	..	..	.....	..	...	..	...	49	....
...	T	D	.....	....	UF (59)	C	14.0	2450	.....	....	....	....	...	..	..	.....	..	...	..	...	164	1.5
...	T	S	.....	....	O	O	....	....	3Du	R	....	....	...	..	..	.....	..	...	..	...	65	0.4
...	M	D	.....	....	UF (65)	C	14.5	2600	2Du	S	....	....	...	..	..	.....	..	...	..	...	40	0.3
...	M	V	.....	....	SS	C	13.8	2380	Du	R	.....	.....	...	..	..	.....	..	...	..	...	35	....
...	....	....	.....	....	.....	.....	....	....	....	....	1.0	4475	GE	..	1	9	A	1.1	2	...	30	1.7
...	M	S	M	S	UF (286)	C	13.6	2300	2T	R	....	....	...	..	..	.....	..	...	..	...	200	....
...	M	V	M	D	O, G	O, G	....	....	1M, 1T	R	....	....	...	..	..	.....	..	...	..	...	170	....
RE	T	S, D	T	S, D	PC	C	14.0	2900	T	S	....	....	...	..	..	.....	..	...	..	...	390	....
...	T	S	.....	....	TG (231)	Cb	12.5	2600	2T	S	....	....	...	..	..	.....	..	...	..	...	175	....
...	.....	....	T	S	G	G	1.1	....	1M, 2T, 1Du	S, R	....	....	...	..	..	.....	..	...	..	...	152	....
...	T	S	.....	....	O, La	O, La	18.5	....	2Du	R	....	....	...	..	..	.....	..	...	..	...	103	....
...	T	S	.....	....	UF (225)	C	13.5	2900	.....	....	....	....	...	..	..	.....	..	...	..	...	250	....
...	.....	....	.....	....	WW (208)	WW	9.0	....	T	S	....	....	...	..	..	.....	..	...	..	...	254	4.0
...	.....	....	.....	....	TG	C	11.5	....	2T	S	....	....	...	..	..	.....	..	...	..	...	50	....
...	1M, 1T	S	.....	....	UF (54)	C	14.0	2600	2Du	S, R	0.4	....	M	17	..	.....	..	...	..	...	....	....
...	.....	....	2M	D	O	O	18.5	....	2Du	R	....	....	...	..	..	.....	..	...	..	...	12	....
...	M	D	.....	....	UF (68)	C	14.0	2500	1M, 1T	R	....	....	...	..	..	.....	..	...	..	...	....	....
...	.....	....	.....	....	UF (87)	C	14.6	2750	T	Hy	....	....	...	..	..	.....	..	...	..	...	69	....
...	M	....	M	....	UF	C	....	2800	.....	....	....	....	...	..	..	.....	..	...	..	...	....	....
...	M	D	.....	....	PC	C	14.3	....	T	S	....	....	...	..	..	.....	..	...	..	...	210	11.5
...	T	V, D	T	D	SS (115)	C	11.5	1900	.....	....	....	....	...	..	..	.....	..	...	..	...	180	....
...	T	V, D	T	D	G, O	G, O	1.0	....														
...	T	D	.....	....	UF (81)	C	12.0	....	2Du	R	....	....	...	..	..	.....	..	...	..	...	66	....
...	M	D	M	....	O	O	18.4	....	2M, 2T	....	....	....	...	..	..	.....	..	...	..	...	260	....
...	.....	....	.....	....	O, G	O, G	....	....	2Du	....	....	....	...	..	..	.....	..	...	..	...	25	....
...	T	S, V	.....	....	PC, Ck	C, Ck	13.0	....	2T	S, R	....	....	...	..	..	.....	..	...	..	...	180	....
...	M	V	.....	....	UF	C	14.1	2400	Du	R	....	....	...	..	..	.....	..	...	..	...	18	....
TU	T	S	T	S	PC, O	C, O	....	....	.....	....	....	....	...	...	..	.....	..	...	..	...	278	....
...	.....	....	.....	....	O, G	O, G	....	....	2Du	R	....	....	...	..	..	.....	..	...	..	...	150	....
...	T	D	.....	....	O	O	....	....	.....	....	....	....	...	..	..	.....	..	...	..	...	50	....
...	.....	....	.....	....	UF (52)	C	14.0	2800	2Du	R	....	....	...	..	..	.....	..	...	..	...	18	....
...	M	V	.....	....	UF (62)	C	13.5	2300	2Du	R	....	....	...	..	..	.....	..	...	..	...	36	....
...	.....	....	.....	....	O	O	19.0	....	2Du	R	.....	.....	...	..	..	.....	..	...	..	...	75	....
...	.....	....	.....	....	.....	.....	....	....	.....	....	0.3¶	4485	TE	1.5	..	.....	A	0.7	2	Ad	18	0.8

UNDER FEED-PUMP DRIVE

M — 1 Motor-driven pump
2M — 2 Motor-driven pumps, etc
T — 1 Turbine-driven pump
2T — 2 Turbine-driven pumps, etc
Du — 1 Duplex reciprocating steam pump
2Du — 2 Duplex pumps, etc
Si — 1 Simplex reciprocating steam pump
2Si — 2 Simplex pumps, etc

UNDER FEED-PUMP FLOW CONTROL

Hy — Hydraulic coupling
Ma — Magnetic coupling
R — Pump regulator
S — Variable-speed driver

UNDER TURBINE MANUFACTURER

AC — Allis-Chalmers Mfg Co
EL — Elliott Co
GE — General Electric Co
M — Moore Steam Turbine Co
Mi — Murray Iron Works Co
TE — Terry Steam Turbine Co
WE — Westinghouse Electric & Mfg Co

UNDER GENERATOR COOLING

A — Air
H — Hydrogen

UNDER CONDENSER-TUBE-MATERIAL

Ad — Admiralty
Br — Aluminum Bronze
CP — Arsenical Copper
Mu — Munts Metal

GENERAL NOTES:

† — Now operating at 125 lb
* — Designed for future operation at higher pressure
** — Total capacity in turbines; individual data not available
‡ — Mixed-pressure turbine
E — Under turbine capacity, indicates engine generator
¶ — Exhaust turbine

Typical Institutional Steam Plants Installed

Compiled by S A Tucker and L N Rowley, *Associate Editors*

Company	Location	Consulting Engineers	First Operation, New Units	Nominal Pressure, Lb	Nominal Steam Temperature, F	BOILERS: Number	BOILERS: Capacity, Each, 1000 Lb per Hr	BOILERS: Manufacturer	Furnace Volume, 1000 Cu Ft	Furnace Bottom	Economizer Surface per Boiler, 1000 Sq Ft	Air — Heater Surface per Boiler, 1000 Sq Ft
Mass. Memorial Hospital	Boston, Mass.	R D Kimball Co.	10–41	200	387	2	20	RS	1.2	...	...	....
City Hospital No 1	St. Louis, Mo.	.....	1–41	200	438	1	50	EC	2.1	...	...	....
Maryland St Penal Farm	Breathedsville, Md.	Whitman, Requardt & Smith	11–41	175	370	2	18	EC	0.7	...	...	....
Worcester Polytechnic Inst.	Worcester, Mass.	.....	9–41	155	380	1	18	RS	0.5	...	...	....
Federal Reserve Bank	New York, N. Y.	Meyer, Strong & Jones	8–41	150	...	5	12	BW	...	...	...	....
Cincinnati General Hosp.	Cincinnati, Ohio	O W Motz	8–41	140	361	2	26	BW	1.0	DB	...	....
Gunter Hotel Corp	San Antonio, Texas	E W Staph	10–41	125	...	1	9	BW	0.8	...	...	....
Yale University	New Haven, Conn.	.....	9–40	125	353	..	....	....	...	...	...	....
Agnew State Hosp.	Agnew, Calif.	C A Hendertong	1941	120	341	1	15	EC	0.8	...	...	....
			1941	120	341	2	11	EC	0.7	...	...	....
Fullerton Jr College	Fullerton, Calif.	.....	1–41	100	338	1	13	BW	...	...	...	....
Baylor University	Waco, Texas	.....	12–40	100	329	1	38	BW	1.4	DB	...	....

Typical Municipal Steam Plants Installed

Company	Location	Consulting Engineers	First Operation, New Units	Nominal Pressure, Lb	Nominal Steam Temperature, F	BOILERS: Number	BOILERS: Capacity, Each, 1000 Lb per Hr	BOILERS: Manufacturer	Furnace Volume, 1000 Cu Ft	Furnace Bottom	Economizer Surface per Boiler, 1000 Sq Ft	Air — Heater Surface per Boiler, 1000 Sq Ft
City of Celina	Celina, Ohio	O C Beiswenger	1–42	450	700	1	30	BW	...	...	...	....
Provo City Corp	Provo, Utah	Ullen Cont Corp.	7–41	450	725	1	30	CE	0.8	...	...	....
City Water & Light Dept.	Dyersburg, Tenn.	.....	....	450	700	1	90	BW	...	...	...	....
			....	450	700	1	60	BW	...	...	...	....
			....	200	550	1	32	BW	...	...	...	....
			....	200	550	1	25	BW	...	...	...	....
Wyandotte Municipal Service	Wyandotte, Mich.	Burns & McDonnell	2–42	425	720	1	90	WI	3.1	...	...	4.5
City of Chanute	Chanute, Kansas	.....	9–41	425	750	1	50	BW	2.2	...	...	2.6
City of Fort Collins	Fort Collins, Colo.	G H Palmes	9–41	420	700	1	25	EC	...	...	...	....
Dept of Public Utilities	Colorado Springs, Colo.	.....	5–42	410	750	1	100	BW	5.1	...	...	12.5
Dept of Public Utilities	Owatoma, Minn.	W Burlingame	....	400	750	1	80	....	4.0	...	...	3.9
City of Dover	Dover, Ohio	W C Kammerer	5–42	400	750	1	50	BW	2.3	...	...	....
City of Clay Center	Clay Center, Kansas	Burns & McDonnell	4–42	400	750	1	25	CE	...	...	...	....
			4–42	400	750	1	25	EC	...	...	...	....
Denison Light & Power	Denison, Iowa	.....	3–41	400	750	..	....	....	...	...	...	....
Board of Public Utilities	Kansas City, Kansas	Burns & McDonnell	3–43	400	750	1	150	BW	1.9	ST	1.8	19.6
Electric & Water Dept.	Marshfield, Wis.	J V Edeskuty	1942	400	700	2	40	CE	...	...	...	....
Corp of Union City	Union City, Tenn.	.....	9–41	400	700	1	35	BW	1.6	...	...	....
Board of Public Works	South Haven, Mich.	Hamilton & Weeber	7–40	275	550	..	....	...	...	...	...	....
Eugene Water Board	Eugene, Oregon	.....	8–41	250	700	1	120	BW	8.0	...	...	19.2
City of Rushville	Rushville, Ind.	Bevington & Williams	1–40	225	500	1	20	WI	...	...	...	....
Town of Gunnison	Gunnison, Colo.	F E Keenan	1–42	160	...	2	11	UI	...	...	...	....
City of Richmond	Richmond, Va.	.....	1–42	140	...	1	25	RS	1.0	...	...	....
Borough of Vineland	Vineland, N. J.	H A Kuljian Co.	1–42	...	...	..	....	...	...	...	...	....
City of Richmond	Richmond, Ind.	.....	10–42	...	...	..	...	...	...	...	...	....

ABBREVIATIONS AND GENERAL NOTES

UNDER BOILER MANUFACTURER
BW — Babcock & Wilcox Co
CE — Combustion Engineering Co
EC — Erie City Iron Works
RS — Riley Stoker Corp
TI — Titusville Iron Works Co
UI — Union Iron Works
WI — Wickes Boiler Co

UNDER AIR-HEATER TYPE
PL — Plate
RE — Regenerative
TU — Tube

UNDER FAN DRIVE
M — 1 Motor per fan
2M — 2 Motors per fan
T — 1 Turbine per fan
1M,1T — 1 Motor, 1 turbine per fan
*M** — Single motor driving both forced- and induced-draft fans

UNDER AIR-VOLUME CONTROL AND GAS-VOLUME CONTROL
D — Damper
Hy — Hydraulic Coupling
Mc — Magnetic coupling
S — Variable-speed driver
V — Vane

UNDER FIRING AND FUEL TYPE
C — Bituminous coal
CG — Chain-grate stoker
G — Natural gas
O — Oil
PC — Pulverised coal
SS — Spreader stoker
TG — Traveling-grate stoker
UF — Underfeed stoker
WW — Wood waste or hogged fuel
Numbers in parenthesis equal stoker grate area in sq ft, projected

or Under Construction Since July, 1940

Air-Heater Type	FD FANS: Drive	FD FANS: Air-Volume Control	ID FANS: Drive	ID FANS: Gas-Volume Control	Firing	FUEL: Type	FUEL: Heating Value, 1000 Btu per Lb or per Cu Ft	FUEL: Ash-Fusion Temperature, F	FEED PUMPS: Drive	FEED PUMPS: Flow Control	TURBINES: Capacity, 1000 Kw	TURBINES: Speed, Rpm	TURBINES: Manufacturer	TURBINES: Backpressure, Lb Abs	TURBINES: Number of Bleed Points	TURBINES: Bleed Press, Lb Abs	Generator Cooling	CONDENSER: Surface, 1000 Sq Ft	CONDENSER: Number of Water Passes	CONDENSER: Tube Material	Total Blr Capacity, Incl New Units, 1000 Lb per Hr	Total Gen Capacity, Incl New Units, 1000 Kw
...	.....	....	.....	....	O	O	18.5	....	2T	R	0.3	3600	WE	40	..	.....	..	...	..	...	40	0.5
...	M	V	.....	....	CG (157)	C	11.0	....	T	S	0.2	3600	WE	40	..	.....	..	...	..	...	140	1.3
...	1M, 1T	V	.....	....	UF (51.6)	C	13.6	2500	2Du	R	0.2E	225	EL	20	..	.....	..	...	..	...	36	0.4
...	M	V	.....	....	UF (55)	C	14.5	2700	1M, 1Du	R	....	....	...	..	..	.....	..	...	..	...	36	0.2
...	.....	....	.....	....	O	O	18.0	....	2Du	R	0.6	3600	TE	..	1	3	A	...	2	...	60	2.3
...	1M, 1T	S	.....	....	UF (80)	C	14.0	2800	.....	....	....	....	...	..	..	.....	..	...	..	...	130	0.8
...	.....	....	.....	....	G	G	1.0	....	2Du	R	....	....	...	..	..	.....	..	...	..	...	15	....
...	.....	....	.....	....	.....	.....	....	....	.....	....	0.8	3800	WE	20	..	.....	..	...	..	...	....	1.9
...	.....	....	1M, 1T	....	G	G	1.2	....	2Du	R	....	....	...	..	..	.....	..	...	..	...	49	....
...	.....	....	1M, 1T	....	G	G	1.2														....	....
...	.....	....	.....	....	O	O	....	....	.....	....	....	....	...	..	..	.....	..	...	..	...	25	....
...	.....	....	.....	....	G	G	1.0	....	2Si	S	....	....	...	..	..	.....	..	...	..	...	54	....

or Under Construction Since July, 1940

Air-Heater Type	FD FANS: Drive	FD FANS: Air-Volume Control	ID FANS: Drive	ID FANS: Gas-Volume Control	Firing	FUEL: Type	FUEL: Heating Value 1000 Btu per Lb or per Cu Ft	FUEL: Ash-Fusion Temperature, F	FEED PUMPS: Drive	FEED PUMPS: Flow Control	TURBINES: Capacity, 1000 Kw	TURBINES: Speed, Rpm	TURBINES: Manufacturer	TURBINES: Backpressure, Lb Abs	TURBINES: Number of Bleed Points	TURBINES: Bleed Press Lb Abs	Generator Cooling	CONDENSER: Surface, 1000 Sq Ft	CONDENSER: Number of Water Passes	CONDENSER: Tube Material	Total Blr Capacity, Incl New Units, 1000 Lb per Hr	Total Gen Capacity, Incl New Units, 1000 Kw
...	.....	....	.....	....	TG (130)	C	12.0	....	1M, 1T	....	2.0	3600	GE	..	..	.....	A	...	..	...	....	....
...	M	V	.....	....	TG (98)	C	11.9	2400	3M, 1T	R	2.5	3600	EL	0.9	2	85–6	A	3.0	2	Ad	80	6.5
...	2M	S, D	.....	....	UF	C	12.0	2000		R	....											
...	2M	S, D	.....	....	UF	C	12.0	2000	6T, 1Du	R	....	3600	WE	14.0	..	.....	A	...	..	...	207	8.0
...	2M	S, D	.....	....	UF	C	12.0	2000		R	....											
...	2M	S, D	.....	....	UF	C	12.0	2000		R	....											
TU	1M, 1T	S, V	1M, 1T	Ma	SS (130)	C	13.9	2650	.....	....	6.0	3600	DL	1.5	3	125–15	A	6.8	2	Ad	190	12.0
TU	1M, 1T	S, D	1M, 1T	S, D	O, G	O, G	....	....	1M, 1T	R	....	....	....	....	..	.....	..	...	..	...	....	....
...	.....	....	.....	....	.....	.....	....	....	.....	....	4.0	3600	WE	0.8	2	10– 5	A	5.6	1	CP	75	7.0
TU	M	Hy	M	Hy	O	O	....	....	M	R	5.0	3600	GE	0.5	3	205–22	A	6.0	2	Ad	225	15.0
TU	1M, 1T	S,D,Hy	1M, 1T	S,D,Hy	G	G	....	....	.....	....	....	....	...	..	..	.....	..	...	..	...	....	....
...	1M, 1T	V	.....	D	UF (170)	C	12.4	2200	.....	....	....	....	...	..	..	.....	..	...	..	...	138	4.7
...	M	....	M	....	G	G	1.0	....	M	S	....	....	...	..	..	.....	..	...	..	...	....	....
...	M	....	M	....	G	G	1.0	....	T	Hy	1.5	3600	AC	..	2	.....	A	1.8	2	...	50	3.0
...	.....	....	.....	....	.....	.....	....	....	.....	....	1.5	3600	GE	..	2	15	A	3.0	2	Mu	56	3.0
PL	M	Hy	M	Hy	PC	C	11.5	2200	.....	....	30.0	1800	WE	1.0	3	115–7.7	A	40.0	2	Ad	865	99.0
...	T	....	.....	....	PC	C	12.0	....	2M, 1T	....	4.0	3600	GE	..	3	125–30	..	5.0	..	...	....	8.8
...	2M	V	.....	....	UF (110)	C	11.8	2000	2T	R	....	....	...	..	..	.....	..	...	..	...	60	3.5
TU	1M, 1T	S, D	1M, 1T	S	WW (268)	WW	8.9	....	2M	R	3.0	3600	GE	0.8	3	.....	A	4.3	2	Ad	80	6.0
...	2M	V	.....	....	TG	C	11.0	2400	1M, 1T	....	7.5	3600	WE	1.0	3	25–11	A	7.5	1	Ad	200	14.5
...	M	....	M	....	SS	C	11.4	2190	1M, 1Du	Hy	2.0	3600	M	14.0	..	.....	A	...	2	Mu	52	4.3
...	1M, 1T	S, D	.....	....	SS (72)	C	14.0	2600	1M, 2Du	R	0.6	3600	GE	0.8	..	.....	A	0.6	2	Mu	22	1.2
...	.....	....	.....	....	.....	.....	....	....	.....	....	....	....	...	..	..	.....	..	...	..	...	75	....
...	.....	....	.....	....	.....	.....	....	....	.....	....	4.0	3600	EL	0.1	2	100– 6	A	...	2	...	....	11.0
...	.....	....	.....	....	.....	.....	....	....	.....	....	15.0	3600	GE	1.0	4	192–50	A	15.1	2	Ad	....	45.0

UNDER FEED-PUMP DRIVE
M — 1 Motor-driven pump
2M — 2 Motor-driven pumps, etc
T — 1 Turbine-driven pump
2T — 2 Turbine-driven pumps, etc
Du — 1 Duplex reciprocating steam pump
2Du — 2 Duplex pumps, etc
Si — 1 Simplex reciprocating steam pump
2Si — 2 Simplex pumps, etc

UNDER FEED-PUMP FLOW CONTROL
Hy — Hydraulic coupling
R — Pump regulator
S — Variable-speed driver

UNDER TURBINE MANUFACTURER
AC — Allis-Chalmers Mfg Co
DL — De Laval Steam Turbine Co
EL — Elliott Co
GE — General Electric Co
M — Moore Steam Turbine Co
TE — Terry Steam Turbine Co
WE — Westinghouse Electric & Mfg Co

UNDER GENERATOR COOLING
A — Air

UNDER CONDENSER TUBE MATERIAL
Ad — Admiralty
CP — Arsenical Copper
Mu — Munts Metal

GENERAL NOTES:
E — Under turbine capacity, indicates engine generator

Hydroelectric Projects Built or on Order in

Compiled by F A Annett, Associate Editor — Company	Designing Engineers	Project Name	[1] New or Redevelop	River	State	Project Started	[1] Dam Type	Crest Length, Feet	Max Height Feet	Initial Operation	Initial Horsepower
NEW ENGLAND STATES											
Bangor Hydro-Electric Co	Bangor Hydro-Electric Co	Milford	New	Penobscot	Me.	1941	.....	.....	...	.....	.....
Baltic Mills	.....	Baltic	.....	.....	Conn.	1940	.....	.....	...	1941	.....
MIDDLE ATLANTIC STATES											
Hydraulic Race Co	Hydraulic Race Co	South Tunnel	Redev	Barge Canal	N.Y.	1941	.....	.....	...	1941	6,000
Pennsylvania Edison Co	.....	Huntingdon	.....	.....	Pa.	1940	.....	.....	...	1941	.....
McCoy & Linn	.....	Bellefonte	.....	.....	Pa.	1940	.....	.....	...	1941	.....
EAST NORTH CENTRAL STATES											
Moline Rock Island Mfg Co	.....	.....	.....	.....	Ill.	....	.....	.....	...	1941	.....
Illinois-Iowa Power Co	.....	Marseilles	.....	.....	Ill.	1940	.....	.....	...	1941	.....
Watervliet Paper Co	.....	.....	.....	.....	Mich.	1940	.....	.....	...	1940	.....
Cliffs Power & Light Co	.....	Hoist	.....	.....	Mich.	1940	.....	.....	...	1941	.....
Consol Water & Paper Co	.....	Wis. Rapids	.....	.....	Wis.	1940	.....	.....	...	1941	.....
Lake Superior District Power Co	Holland, Ackerman & Holland	Ladysmith	Redev	Flambeau	Wis.	1940	.....	182	...	1941	3,000
Lake Superior District Power Co	.....	Saxon	.....	.....	Wis.	1940	.....	.....	...	1941	.....
City of Traverse	.....	.....	.....	.....	Mich.	1940	.....	.....	...	1941	.....
Ohio Power Co	.....	Fremont	.....	.....	Mich.	1940	.....	.....	...	1941	.....
WEST NORTH CENTRAL STATES											
Central Neb. Pub Pwr & Irrig Dist	Owners Eng Staff	Johnson No. 2	New	Platte	Neb.	1939	EF	10,400	160	1941	25,000
Central Neb. Pub Pwr & Irrig Dist	Owners Eng Staff	Johnson No. 1	New	Platte	Neb.	1939	EF	10,400	160	1941	26,000
Central Neb. Pub Pwr & Irrig Dist	Owners Eng Staff	Jeffery Canyon	New	Platte	Neb.	1938	EF	10,400	160	1941	26,000
Granite Falls Light & Water Dept	.....	Granite Falls	.....	Minnesota	Minn.	1940	.....	.....	...	1941	.....
Lanesboro Light & Power Comm	.....	Lanesboro	.....	.....	Minn.	1940	.....	.....	...	1941	.....
SOUTH ATLANTIC STATES											
S. Carolina Public Service Auth	Harza Engineering Co	Santee-Cooper	New	Santee	S.C.	1938	HR	3,100	40	1941	173,300
Nantahala Power & Light Co	Aluminum Co of Amer	Nantahala	New	Nantahala	N.C.	1940	R&E	1,050	250	1942	60,000
Nantahala Power & Light Co	Aluminum Co of Amer	Glenville	New	Tuckasegee	N.C.	1940	R&E	1,310	150	1941	30,000
Randolph Mills	.....	Franklinville	.....	.....	N.C.	1940	.....	.....	...	1941	.....
Solvay Process Co	.....	.....	.....	.....	Va.	....	.....	.....	...	1940	.....
Sellers Mfg. Co	.....	Saxapahaw	.....	.....	N.C.	1940	.....	.....	...	1941	.....
J M Odell Mfg Co	.....	Pittsboro	.....	.....	N.C.	1939	.....	.....	...	1940	.....
Ware Shoals Mfg Co	.....	Glen Raven	.....	.....	N.C.	1939	.....	.....	...	1940	.....
EAST SOUTH CENTRAL STATES											
Tenn. Valley Authority	Tenn. Valley Authority	Kentucky	New	Tennessee	.....	1938	CG	8,650	160	1945	176,000
Tenn. Valley Authority	Tenn. Valley Authority	Pickwick	New	Tennessee	Tenn.	1935	EF	7,715	110	1939	96,000
Tenn. Valley Authority	Tenn. Valley Authority	Wilson	New	Tennessee	Ala.	1918	CGG	4,500	95	1926	260,000
Tenn. Valley Authority	U. S. Bureau Reclam	Wheeler	New	Tennessee	Ala.	1933	CGG	6,335	68	1936	90,000
Tenn. Valley Authority	Tenn. Valley Authority	Watts Bar	New	Tennessee	Tenn.	1939	CGG	2,970	97	1942	126,000
Tenn. Valley Authority	Tenn. Valley Authority	Fort Loudoun	New	Tennessee	Tenn.	1940	CGG	4,835	135	1944	88,000
Tenn. Valley Authority	Tenn. Valley Authority	Cherokee	New	Holston	Tenn.	1940	CG	6,750	212	1942	124,500
Newdale Mica Co	.....	Edwin	.....	.....	Tenn.	1940	.....	.....	...	1941	.....
WEST SOUTH CENTRAL STATES											
Lower Colorado River Authority	Lower Colo River Auth	Marshall Ford	New	Colorado	Texas	1938	CG	700	225	1941	90,000
Grand River Dam Authority	Holway & Neuffer	Pensacola Dam	New	Grand	Okla.	1938	MA	6,100	150	1941	80,000
Brazos River Conserv & Rec Dist	Amberson Constr Co	Possum Kingdom	New	Brazos	Texas	1938	AM	2,740	190	1940	34,000
MOUNTAIN STATES											
U. S. Bureau of Reclamation	U. S. Bur of Reclam	Boulder Dam	New	Colorado	Ariz & Nev.	1931	GA	1,180	730	1936	515,000
U. S. Bureau of Reclamation	U. S. Bur of Reclam	Bulls Head	New	Colorado	Ariz. & Nev.	1941	ERF	1,350	338	1945	220,000
U. S. Bureau of Reclamation	U. S. Bur of Reclam	Green Mt	New	Blue	Colo.	1938	EF	1,300	270	1943	30,000
U. S. Bureau of Reclamation	U. S. Bur of Reclam	Minidoka	Redev	Snake	Idaho	1904	.....	.....	...	1910	8,000
U. S. Government	U. S. Engineer Corps / Harza Engrg Corp	Fort Peck	New	Missouri	Mont.	1933	EF	21,000	250	.....	70,000
Salt River Val Water Users Assn	Association Engineers	Phoenix	.....	.....	Ariz.	1940	.....	.....	...	1941	.....
Uintah Power & Light Co	Richard I Plumb	Pole Creek	New	Uintah	Utah	1914	.....	.....	...	1914	800
Moon Lake Electric Assn	.....	Alta Mont	New	.....	Utah	1940	.....	.....	...	1941	.....
Star Valley Power & Light Co	Ivan Call	Swift River	New	Swift	Wyo.	1939	CG	110	35	1940	.....
Manti City Corp	.....	.....	New	Manti Ct	Utah	1940	.....	.....	...	1941	.....
Beaver City Corp	.....	.....	New	.....	Utah	....	.....	.....	...	1940	.....
Bonners Ferry Lighting Dept	J H Cave & H M Buroker	Moyie River	New	Moyie	Idaho	1941	A	200	90	1941	1,500
PACIFIC COAST STATES											
U. S. Government	U. S. Engineer Corps	Bonneville	New	Columbia	Wash. & Ore.	1933	CG	900	170	1938	137,000
U. S. Bureau of Reclamation	U. S. Bur of Reclam	Grand Coulee	New	Columbia	Wash.	1934	CG	4,500	553	1941	478,000
U. S. Bureau of Reclamation	U. S. Bur of Reclam	Shasta	New	Sacramento	Calif.	1938	CG	3,500	560	1944	419,000
U. S. Bureau of Reclamation	U. S. Bur of Reclam	Keswick	New	Sacramento	Calif.	1941	.....	600	80	.....	100,000
U. S. Bureau of Reclamation	U. S. Bur of Reclam	Parker	New	Colorado	Calif. & Ariz.	1934	CA	800	340	1942	120,000
Imperial Irrigation Dist	U. S. Bur of Reclam	Drop No. 3	New	AA Canal	Calif.	1937	None	.....	...	1941	7,500
Imperial Irrigation Dist	U. S. Bur of Reclam	Drop No. 4	New	AA Canal	Calif.	1937	None	.....	...	1941	13,300
Priest Rapids Irrigation Dist	.....	White Bluffs	.....	.....	Wash.	....	.....	.....	...	1941	.....
Pacific Gas & Electric Co	Pacific Gas & Elec Co	Narrows	New	Yuba	Calif.	1941	CA	1,142	237	1942	13,500
Pacific Gas & Electric Co	Pacific Gas & Elec Co	Potter Valley	Redev	Eel	Calif.	1940	CG	752	130	1940	14,500
Pacific Gas & Electric Co	Pacific Gas & Elec Co	Pit No. 5	New	Pit	Calif.	1941	.....	.....	...	1943	.....
Pacific Gas & Electric Co	Pacific Gas & Elec Co	Dutch Flat	New	Bear	Calif.	1940	A	324	100	1942	29,000
Southern California Edison Co	Southern Calif. Edison Co	Big Creek No. 1	.....	Big Creek	Calif.	....	.....	.....	...	1941	.....
Puget Sound Power & Light Co	Puget Sound Pwr & Lt Co	Electron	.....	.....	Wash.	....	.....	.....	...	1941 1941	....

[1] AC — Allis-Chalmers Mfg Co
BS — Baldwin Southwark Corp
JL — James Leffel & Co
MS — S Morgan Smith Co
NN — Newport News Shipbuilding & Dry Dock Co
PW — Pelton Water Wheel Co
W — Woodward Governor Co
L — Lombard Governor Co
GE — General Electric Co
WE — Westinghouse Elec & Mfg Co
EM — Electric Machinery Co
EC — Elliott Co

the United States from June, 1940 to June, 1941

Added Cap. No. of Units	Date of Added Cap.	Ultimate Cap., Horsepower	No. of Units Installed	Waterwheel Capacity, Horsepower	Waterwheel, Type	Speed, RPM	Static Head, Ft	Design Head, Ft	[1] Waterwheel Manufacturer	[1] Governor Manufacturer	Draft Tube, Type	Scroll Case, Type	Penstock Valves, Type	Generator Capacity, Kva	[2] Thrust-Bearing Location	Power Factor	Kilovolts	Cycles	[1] Generator Manufacturer
1	1941	.....	1	Existing plant has 6,000 hp. installed in eight 25-cycle units															
			1	2,130	Kaplan	120	20.9	17	MS	W	Elbow	Concrete	Head Ga	2,000	AG	0.80	4.15	60	GE
..	....	.....	1	.....	.....	300	.....	.....	.....	.....	.....	.....	.....	1,375	HS	0.80	0.6	60	WE
..	....	.....	1	6,000	Kaplan	200	52–48	50	MS	W	Elbow	Concrete	Butterfly	6,250	AG	0.8	12	60	GE
..	....	.....	1	1,500	Francis	225	35	34	JL	.....	Reconstruction	.....	.....	.....	HS	.....	.....	..	WE
..	....	.....	1	380	Francis	225	17	17	JL	.....	.....	.....	.....	.....	HS	.....	.....	..	WE
..	....	.....	4	.....	.....	100	.....	.....	.....	.....	.....	.....	.....	1,125	AG	0.80	4.8	60	GE
..	....	.....	1	770	Francis	75	16	16	JL	.....	.....	.....	Head Ga	.....	.....	.....	.....	..	WE
..	....	.....	1	446	.....	164	12	12	.....	W	.....	.....	.....	375	AG	0.80	2.3	60	EM
..	....	.....	1	2,400	Francis	360	145	135	AC	W	.....	.....	.....	2,500	HS	0.80	2.5	60	AC
..	....	.....	1	900	Francis	225	30	30	JL	W	Drives generator and grinder			.....	.....	.....	.....	.....	.....
..	....	.....	1	1,500	Propeller	120	16	16	AC	W	.....	.....	Head Ga	1,000	HS	0.90	2.4	60	AC
..	....	.....	2	1,000	Francis	600	140	135	JL	W	Reconstruction	.....	.....	.....	HS	.....	.....	..	GE
..	....	.....	1	375	Francis	257	29	29	JL	.....	.....	.....	Head Ga	.....	.....	.....	.....	..	GE
..	....	.....	1	1,000	Francis	250	40	40	JL	.....	.....	.....	Head Ga	.....	HS	.....	.....	..	WE
..	....	50,000	1	25,000	Francis	164	146	141	NN	W	Elbow	Plate St	Head Ga	20,000	AG	0.90	6.9	60	GE
..	....	26,000	2	13,000	Francis	180	118	98	MS	W	Elbow	Plate St	Head Ga	10,000	AG	0.90	6.9	60	AC
..	....	26,000	2	13,000	Francis	180	116	110	MS	W	Elbow	Plate St	Head Ga	10,000	AG	0.90	6.9	60	AC
..	....	.....	1	450	Francis	300	21	21	JL	W	Conical	Concrete	Head Ga	375	AG	0.80	2.4	60	EM
..	....	.....	1	900	Francis	400	26	26	JL	.....	.....	.....	.....	.....	.....	.....	.....	..	EM
..	....	213,000	2	40,000	Kaplan	120	77–60	70	AC	W	Elbow	Concrete	Head Ga	34,000	BG	0.90	13.8	60	WE
			2	40,000	Prop	120	77–60	70	NN	W	Elbow	Concrete	Head Ga	34,000	BG	0.90	13.8	60	GE
			1	13,000	Kaplan	200	77–60	70	AC	W	Elbow	Concrete	Head Ga	11,350	BG	0.90	13.8	60	GE
..	....	60,000	1	60,000	Francis	450	1,005	950	NN	W	Elbow	Concrete	.....	54,000	AG	0.80	13.2	60	GE
..	....	30,000	1	30,000	Impulse	275	1,215	1,150	AC	AC	.....	.....	.....	27,000	HS	0.90	6.6	60	AC
..	....	.....	1	225	Francis	327	27	27	JL	.....	.....	.....	Head Ga	.....	.....	.....	.....	..	EM
..	....	.....	1	.....	.....	450	.....	.....	.....	.....	.....	.....	.....	1,875	HS	0.80	2.3	60	GE
..	....	.....	1	325	Francis	200	22	22	JL	W	.....	.....	.....	.....	.....	.....	.....	..	AC
..	....	.....	1	800	Francis	800	18	18	JL	W	.....	.....	Head Ga	750	AG	0.80	0.6	60	GE
..	....	.....	1	3,780	Kaplan	360	67	64	MS	W	Elbow	Concrete	Head Ga	3,000	AG	0.80	2.4	60	GE
..	....	220,000	4	44,000	Kaplan	78.3	58.20	48	.....	.....	Elbow	Concrete	Head Ga	35,560	BG	0.90	13.8	60	.....
.	....	288,000	2	48,000	Kaplan	81.8	60–30	43	AC	AC	Elbow	Concrete	Head Ga	36,000	BG	0.90	13.8	60	GE
2	1942		2	48,000	Kaplan	81.8	60–30	43	AC	AC	Elbow	Concrete	Head Ga	40,000	BG	0.90	13.8	60	WE
.	....		4	30,000	Francis	100	95	92	BS	BS	Elbow	Concrete	Head Ga	24,000	AG	0.90	13.8	60	WE
.	....	610,000	4	35,000	Francis	100	95	92	NN	W&L	Elbow	Concrete	Head Ga	28,000	AG	0.90	13.8	60	GE
2	1941		2	35,000	Francis	100	95	92	AC	W	Elbow	Concrete	Head Ga	28,000	AG	0.90	13.8	60	AC
2	1942		2	35,000	Francis	100	95	92	AC	W	Elbow	Concrete	Head Ga	28,000	AG	0.90	13.8	60	AC
.	....	360,000	2	45,000	Prop	85.7	54.43	48	BS	W	Elbow	Concrete	Head Ga	36,000	BG	0.90	13.8	60	GE
2	1941	.....	2	45,000	Prop	85.7	54.43	48	BS	W	Elbow	Concrete	Head Ga	36,000	BG	0.90	13.8	60	GE
..	....	210,000	3	42,000	Kaplan	94.7	60–40	52	BS	W	Elbow	Concrete	Head Ga	33,333	BG	0.90	13.8	60	WE
..	....	176,000	2	44,000	Kaplan	105.8	78–60	65	BS	W	Elbow	Concrete	Head Ga	35,500	BG	0.90	13.8	60	AC
..	....	166,000	3	41,500	Francis	94.7	148–56	100	MS	W	Elbow	Plate St	Head Ga	33,333	BG	0.90	13.8	60	GE
..	....	.....	1	106	Francis	210	15	15	JL	.....	Drives line shaft	.....	.....	.....	.....	.....	.....	..	.....
..	....	90,000	3	30,000	Francis	144	235–100	120	BS	W	Elbow	Plate St	Head Ga	25,000	BG	0.90	13.8	60	GE
..	....	100,000	4	20,000	Francis	150	135–85	115	AC	W	Elbow	Plate St	Head Ga	16,000	BG	0.90	13.8	60	WE
			1	750	Francis	720	135–85	115	AC	W	Elbow	Cast St	Head Ga	625	HS	0.80	0.48	60	WE
..	....	51,000	2	17,000	Francis	171.4	130–63	115	AC	W	Elbow	Plate St	Head Ga	12,500	BG	0.80	6.9	60	GE
			8	115,000	Francis	180	.....	.....	6 AC	W	Elbow	Cast St	Butterfly	82,500	AG	1.00	16.5	60	4 WE
								520	2 PW	W	Elbow	Cast St	Butterfly	82,500	AG	1.00	16.5	60	4 GE
..	....	1,835,000	1	55,000	Francis	237			NN	W	Elbow	Cast St	Butterfly	40,000	AG	1.00	13.3	60	AC
			2	3,500	Impulse	300	584–422		PW	W	House	Service	.....	3,000	HS	0.80	2.4	60	EM
2	1941		2	115,000	Francis	180			BS	W	Elbow	Cast St	Butterfly	82,500	AG	1.00	13.8	60	WE
1	1942		1	115,000	Francis	180		520	AC	W	Elbow	Cast St	Butterfly	82,500	AG	1.00	16.5	60	GE
..	....	275,000	4	55,000	Francis	.....	.....	140	.....	.....	.....	.....	.....	45,000	AG	1.00	13.8	60	.....
..	....	30,000	2	15,000	Francis	257	262–107	203	NN	W	Elbow	Plate St	Head Ga	12,000	AG	0.90	6.9	60	AC
1	1941	26,500	6	Five 1,800 installed in 1909 and one 3,500 installed in 1926															
			1	7,000	Prop	180	50–42	47	BS	W	Elbow	Concrete	Head Ga	6,000	AG	0.80	2.4	60	WE
..	....	150,000	1	50,000	Francis	128.5	.....	170	MS	W	Elbow	.....	Head Ga	38,889	BG	0.90	13.8	60	AC
			1	20,000	Francis	164	.....	140	MS	W	Elbow	.....	Head Ga	16,667	BG	0.90	13.8	60	AC
..	....	.....	1	275	Francis	760	60	56	JL	.....	Elbow	.....	Head Ga	.....	HS	.....	.....	..	GE
1	1941	2,200	1	900	Impulse	450	440	400	PW	W	.....	.....	.....	750	HS	0.80	2.3	60	GE
..	....	.....	2	510	Francis	1,200	260	250	JL	.....	.....	.....	.....	.....	HS	.....	.....	..	GE
..	....	.....	1	750	Francis	1,200	200	171	JL	W	.....	Steel	.....	500	HS	0.80	2.3	60	GE
..	....	520	1	520	Impulse	1,200	2,800	2,700	PW	W	.....	.....	.....	.....	.....	.....	.....	..	.....
..	....	.....	1	750	Impulse	450	.....	350	.....	.....	.....	.....	.....	625	HS	0.80	6.9	60	WE
..	....	3,000	1	1,500	Francis	720	212	200	JL	W	Concrete	Cast St	Head Ga	1,250	AG	0.80	2.5	60	EM
.	....	.....	2	66,000	Kaplan	75	67–22	50	MS	W	[5] EHS	Concrete	Head Ga	54,000	BG	0.80	13.8	60	GE
.	....	.....	1	5,000	Kaplan	275	67–22	50	MS	W	Elbow	Plate St	Head Ga	3,200	AG	0.80	2.4	60	EM
2	1940	729,000	2	74,000	Kaplan	75	67–22	60	MS	W	[5] EHS	Concrete	Head Ga	60,000	BG	0.80	13.8	60	GE
2	1941	.....	2	74,000	Kaplan	75	67–22	60	MS	W	[5] EHS	Concrete	Head Ga	60,000	BG	0.80	13.8	60	GE
4	1942 & 1943		4	74,000	Kaplan	75	67–22	60	MS	W	[5] EHS	Concrete	Head Ga	60,000	BG	0.80	13.8	60	GE
..	....	2,742,000	3	150,000	Francis	120	368–	300	NN	W	Elbow	Cast St	Head Ga	108,000	AG	1.00	13.8	60	WE
			2	14,000	Francis	400	266	335	PW	W	Elbow	Service Units	.....	12,500	AG	0.80	6.6	60	WE
..	....	521,000	4	103,000	Francis	150	480–	330	AC	AC	Elbow	Plate St	Head Ga	75,000	AG	1.00	13.8	60	GE
			2	3,500	Francis	600	243	330	JL	W	Conical	Cast St	.....	2,500	AG	0.80	2.4	60	GE
..	....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25,000	.....	.....	.....	..	.....
1	1943	160,000	3	40,000	Francis	94.7	87–60	80	MS	W	Elbow	Plate St	Head Ga	30,000	AG	1.00	6.9	60	WE
			1	40,000	Francis	94.7	87–60	80	MS	W	Elbow	Plate St	Head Ga	30,000	AG	1.00	6.9	60	WE
..	....	15,000	1	7,500	Prop	100	26	26	BS	W	Elbow	Concrete	Head Ga	6,000	AG	0.80	6.9	60	GE
..	....	26,000	1	13,300	Prop	150	56–49	51	NN	W	Elbow	Concrete	Head Ga	12,000	AG	0.80	6.9	60	EC
..	....	.....	1	2,500	.....	120	23	23	.....	W	.....	.....	.....	2,000	AG	0.80	2.3	60	GE
..	....	13,500	1	13,500	Francis	300	185–240	200	BS	PW	Elbow	Cast St	Butterfly	11,000	AG	0.85	11	60	WE
..	....	14,500	1	6,500	Francis	720	476–450	425	PW	W	Elbow	.....	Butterfly	5,500	HS	0.80	2.4	60	WE
			2	4,000	Francis	450	476–450	425	AC	AC	Elbow	.....	.....	2,500	HS	0.80	2.4	60	AC
..	....	200,000	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	..	.....
..	....	29,000	1	29,000	Francis	400	655–627	596	PW	W	Elbow	Cast St	Butterfly	27,500	HS	0.80	11.0	60	AC
..	....	.....	1	35,000	Impulse	360	.....	1,960	PW	W	Reconstructed	.....	.....	.....	.....	.....	.....	..	.....
			1	20,000	Impulse	.....	.....	1,960	.....	W	Reconstructed	.....	.....	.....	.....	.....	.....	..	.....
..	....	.....	1	10,000	Impulse	257	.....	820	PW	.....	Reconstructed	.....	.....	.....	.....	.....	.....	..	.....
..	....	.....	1	7,500	Impulse	225	.....	820	PW	.....	Reconstructed	.....	.....	.....	.....	.....	.....	..	.....

[1] The term "New" applies to entirely new projects on sites that have not been developed previously. "Redevelop" indicates a project on a site that has been developed previously and may consist of new wheels and settings or an entirely new plant. Reconstruction indicates rebuilding of old equipment.

[2] AG indicates that the thrust bearing is above the generator rotor; BG, thrust bearing located below the rotor; HS, horizontal-shaft design.

[4] CGG, concrete-gravity type with control gates; EF, earth fill; AM, Amburgen; HR, hollow reinforced; P&G, piers and gates; REF, rolled earth fill; CG, concrete gravity; MA, multiple arch; GA, gravity arch; CA, constant arch; RFC, rock filled timber crib; R&E, rock and earth filled; A, arch.

[5] EHS, elbow with horizontal splitter plate; VS, vertical steel.

Location and Capacity of All Government Hydro Projects

Federal Power Commission's Proposed Program of New Hydro Installations

(For equipment now being installed see table on page 104)

Installing Organization	River drainage, Basin	Project Name	State	Kilowatts to be Installed				
				1943	1944	1945	1946	Total
REGION I								
	Merrimack	Blackwater	N. H.	[1] 7,000				7,000
	Merrimack	Lower Hillsboro	N. H.			12,000		12,000
	Merrimack	Bennington	N. H.	Storage				
	Merrimack	Livermore Falls	N. H.		12,000			12,000
	Merrimack	Franklin Falls	N. H.		[1] 14,000			14,000
	Connecticut	Knightsville	Mass.	[1] 5,000				5,000
	Connecticut	Newfane	Vt.				40,000	40,000
	Connecticut	Upper 15-Mile Falls	N. H.				70,000	70,000
	Connecticut	Victory	Vt.		Storage			
	Connecticut	Enfield	Conn.	30,000				30,000
	St Lawrence	St Lawrence	N. Y.		550,000	350,000		900,000
	Black	Panther Mountain	N. Y.		Storage			
Safe Harbor Water Power Corp.	Susquehanna	Safe Harbor	Pa.				[2] 60,000	60,000
Susquehanna Electric Co.	Susquehanna	Conowingo	Md.				[2] 72,000	72,000
REGION II								
	Clarion	Mill Creek	Pa.				60,000	60,000
	Clarion	Foxburg	Pa.				50,000	50,000
	Youghiogheny	Confluence	Pa.	[1] 24,000				24,000
	Youghiogheny	Crellin	Md.	Storage				
	Youghiogheny	Victoria A	Pa.	19,000				19,000
	Youghiogheny	Victoria B	Pa.	15,000				15,000
	Youghiogheny	Victoria C	Pa.	10,000				10,000
	Youghiogheny	Victoria D	Pa.	Storage				
	Youghiogheny	Sang Run	Md.	30,000				30,000
	Youghiogheny	Swallow Falls	Md.	15,000				15,000
	Cheat	No. 12	W. Va.			50,000		50,000
	Cheat	No. 13B	W. Va.				60,000	60,000
	Cheat	No. 14	W. Va.				40,000	40,000
	Cheat	No. 15	W. Va.				40,000	40,000
	Cheat	No. 18	W. Va.				40,000	40,000
	New	Bluestone	W. Va.	60,000				60,000
	Juniata	Raystown	Pa.				60,000	60,000
Tennessee Valley Authority	Tennessee	Hiwassee-Ocoee	N. C.	[3] 210,000				210,000
Tennessee Valley Authority	Tennessee	Holston	Tenn.		135,000			135,000
Tennessee Valley Authority	Tennessee	Fontana	N. C.			300,000		300,000
	Cumberland	Wolf Creek	Ky.				[4] 125,000	125,000
REGION III								
	Santee	Blairs	S. C.				40,000	40,000
	Santee	Clinchfield	S. C.			Storage		
	Santee	Frost Shoals	S. C.				20,000	20,000
City of High Point, N. C.	Yadkin	High Point	N. C.		[5] 21,000			21,000
	Savannah	Clark Hill	S. C.		[6] 70,000		[6] 70,000	140,000
	Coosa	Allatoona	Ga.		33,000			33,000
	Chattahoochee	Roswell	Ga.				25,000	25,000
	Potomac	Millville	W. Va.			50,000		50,000
	Potomac	Harpers Ferry	W. Va.				30,000	30,000
REGION IV								
	Michigamme	Way Dam	Mich.	[1] Storage				
	Michigamme	Peavy Falls	Wis.	15,000				15,000
REGION V								
	Arkansas	Nimrod	Ark.	[1] 7,000				7,000
	Arkansas	Markham Ferry	Ark.	30,000				30,000
	Arkansas	Fort Gibson	Ark.	30,000				30,000
	Red	Denison	Okla. & Texas		[1] 70,000			70,000
	White	Norfolk	Ark.	[1] 60,000				60,000
	White	Bull Shoals	Ark.			110,000		110,000
	White	Table Rock	Mo.				60,000	60,000
	Neches	Rockland	Texas			9,000		9,000
	Neches	McGee Bend	Texas			15,000		15,000
	Neches	Dam A	Texas			5,000		5,000
	Neches	Dam B	Texas			5,000		5,000
Brazos River Conserv & Rec Dist.	Brazos	Whitney	Texas		20,000			20,000
	Guadalupe	Canyon	Texas			10,000		10,000
REGION VI								
U. S. Bureau of Reclamation	Columbia	Grand Coulee	Wash.	324,000	108,000	108,000	108,000	648,000
	Puget Sound	Nisqually	Wash.		90,000			90,000
	Fayette	Scriver Creek	Idaho				50,000	50,000
	Flathead	Hungry Horse	Mont.				172,000	172,000
	Snake	Anderson Ranch	Idaho				30,000	30,000
	Sacramento	Cresta	Calif.	68,000				68,000
	Sacramento	Pugla	Calif.	80,000				80,000
	San Joaquin	Red Mt. Bar	Calif.	15,000				15,000
REGION VII								
U. S. Bureau of Reclamation	Sacramento	Shasta	Calif.		[7] 75,000			75,000
U. S. Bureau of Reclamation	Sacramento	Keswick	Calif.		75,000			75,000
U. S. Bureau of Reclamation	Colorado	Boulder Dam	Ariz. & Nev.	[2] 165,000				165,000
U. S. Bureau of Reclamation	Colorado	Parker	Ariz. & Calif.	[8] 30,000				30,000
U. S. Bureau of Reclamation	Colorado	Bulls Head	Ariz. & Nev.			[3] 90,000		90,000
	San Joaquin	Pine Flat	Calif.			15,000		15,000
Total				1,249,000	1,273,000	1,129,000	1,322,000	4,973,000

[1] To be installed at dams now being built by U. S. Corps of Engineers.
[2] Additions to existing plants.
[3] Authorized in whole.
[4] Authorized in part.
[5] Proposed for early construction by City of High Point, N. C.
[6] Believed to be covered by general authorization.
[7] Fifth unit for Shasta-Dam plant now being built under direction of U. S. Bureau of Reclamation.
[8] Fourth unit for Parker-Dam plant now being built under direction of U. S. Bureau of Reclamation.

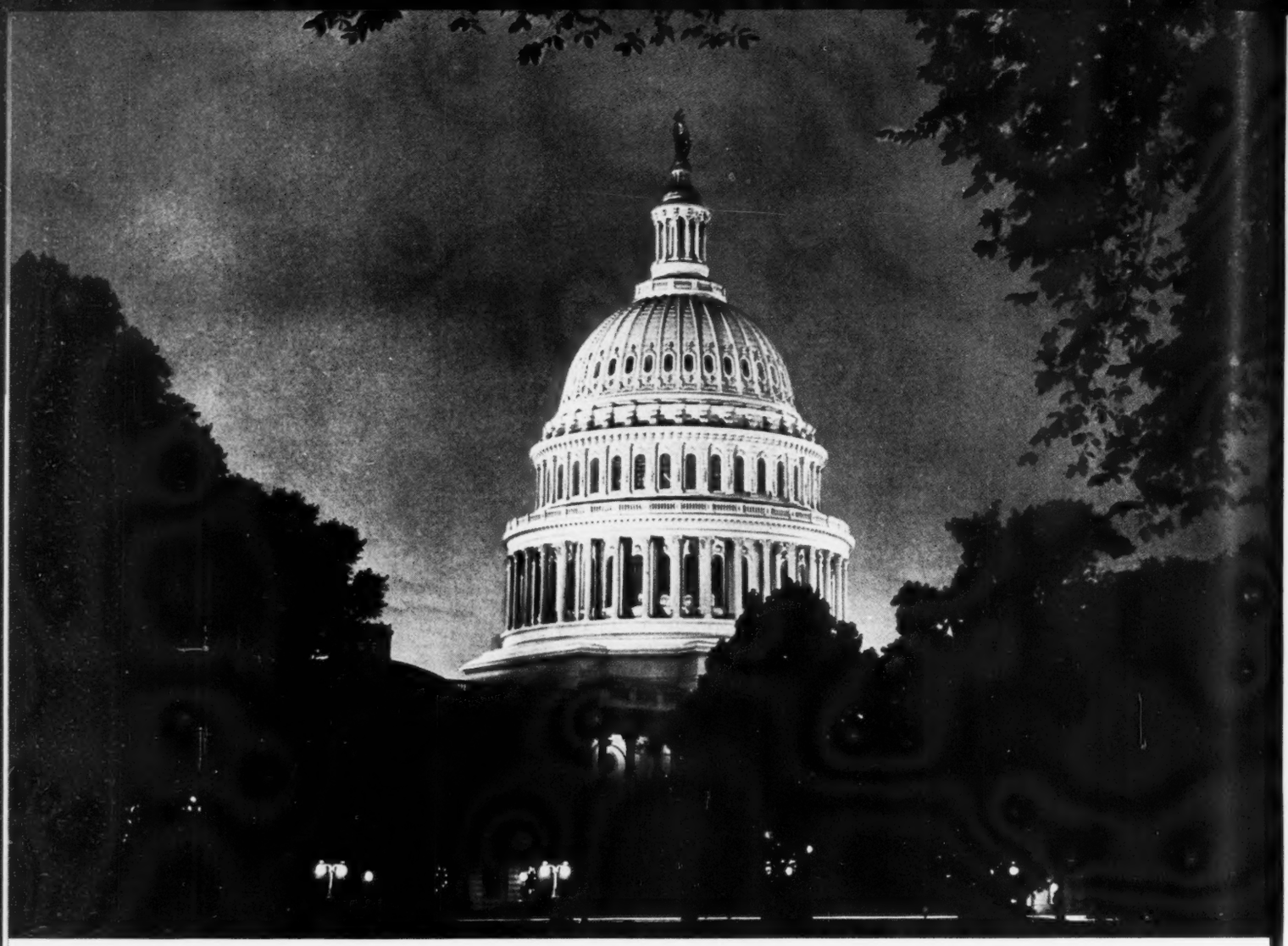

Photo Courtesy American Airlines, Inc.

RILEY BOILERS PLAY IMPORTANT PART IN NATIONAL DEFENSE PROGRAM

Many of the country's plants . . . most vital for national defense . . . have recently installed or purchased Riley equipment. A few of these plants are listed on the following page. The Riley Stoker Corporation is happy to be in a position to play such an important part in the defense program.

To meet the increased demand for Riley Steam Generating Equipment, the Riley Stoker Corporation has greatly increased its productive capacity.

These enlarged steam generating equipment manufacturing facilities have enabled the Riley Stoker Corporation to make deliveries ahead of shipping promises in many cases, in spite of the tremendous expansion in Riley Boiler sales.

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St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orleans

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has recently been installed or purchased for all of these plants, vital to the defense program

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Curtiss-Wright Corp., Buffalo, N. Y.
Curtiss-Wright Corp., Port Columbus, Ohio
Curtiss-Wright Corp., St. Louis, Mo.
Curtiss-Wright Corp., Caldwell, N. J.
Consolidated Aircraft Corp., San Diego, Cal.
Ft. Worth Aircraft Assembly Plant, Fort Worth, Texas
Tulsa Aircraft Assembly Plant, Tulsa, Okla.

METALS AND METAL PRODUCTS

Dow Chemical Co. (Magnesium), Freeport, Texas
Carnegie-Illinois Steel Corp., Rankin, Pa.
Carnegie-Illinois Steel Corp., Charleston, W. Va.
Henry Disston & Sons, Philadelphia, Pa.
American Steel & Wire Co., Worcester, Mass.
American Brass Co., Waterbury, Conn.
American Brass Co., Kenosha, Wis.
A. O. Smith Co., Milwaukee, Wis.
Nevada Consolidated Copper Corp., McGill, Nev.
Revere Copper & Brass Co., Chicago, Ill.
Wisconsin Steel Co., Chicago, Ill.
Scovill Manufacturing Co., Waterbury, Conn.
Aluminum Industries, Inc., Cincinnati, Ohio

OIL AND GASOLINE

Standard Oil Co. of California, Richmond, Calif.
Standard Oil Co. of Indiana, Wood River, Ill.
Standard Oil Co. of N. J., Bayway, N. J.
Humble Oil & Refining Co., Baytown, Texas
Shell Oil Co., Wood River, Ill.
Bahrein Petroleum Co., Bahrein Islands, Persia
Standard Oil Co. of California (for Arabia)

MUNITIONS

Winchester Repeating Arms Co., New Haven, Conn.
Western Cartridge Co., E. Alton, Ill.
Frankfort Arsenal, Frankfort, Pa.

CHEMICALS

Cliffs Dow Chemical Corp., Marquette, Mich.
Carbide & Carbon Chemicals Corp., S. Charleston, W. Va.
Monsanto Chemicals Corp., Nitro, W. Va.
American Cyanamid Co., Calco Chemicals Div., Bound Brook, N. J.
Heyden Chemical Co., Fords, N. J.
Reilly Tar & Chemical Co., Indianapolis, Ind.
Parke Davis Co., Detroit, Mich.

PUBLIC UTILITIES

Union Electric Co. of Illinois, Venice, Ill.
Carolina Power & Light Co., Moncure, N. C.
Houston Lighting & Power Co., Houston, Texas
Commonwealth & Southern Corp. (for Southern Indiana Gas & Electric Co., Evansville, Ind.)
City of Los Angeles, Calif.
Northwestern Public Service Co., Aberdeen, S. D.
Lake Superior District Power Co., Ashland, Wis.
Tri-state Power Co-operative, Genoa, Wis.
Natrona Power & Light Co., Natrona, Pa.
Florida Power & Light Co., Ft. Lauderdale, Fla.
Interstate Power Co., Clinton, Iowa
City of Taunton, Mass.

ADDITIONAL PLANTS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Norton Company, Worcester, Mass.
Bullard Machine Co., Bridgeport, Conn.
Kellogg Company, Battle Creek, Mich.
American Viscose Co., Nitro, W. Va.
American Hoist & Derrick Co., St. Paul, Minn.
Peninsula Plywood Corp., Port Angeles, Wash.
Utica Knitting Co., Utica, N. Y.
Winchester Tanning Co., Winchester, N. H.
Pratt & Read Co., Ivoryton, Conn.
North & Judd Mfg. Co., New Britain, Conn.
Modine Manufacturing Co., Racine, Wis.
Swift & Company, St. Paul, Minn.
Masonite Corp., Laurel, Miss.
Ruberoid Company, Joliet Ill.
Campbell Soup Co., Camden, N. J.
Nicholson File Co., Providence, R. I.

U. S. ARMY AND NAVY PLANTS

U. S. Military Academy, West Point, N. Y.
U. S. Naval Operating Base, Norfolk, Va.
U. S. Norfolk Navy Yard, Portsmouth, Va.
U. S. New York Navy Yard, Brooklyn, N. Y.
U. S. Naval Air Station, Pensacola, Fla.
U. S. Naval Training Station, Great Lakes, Ill.

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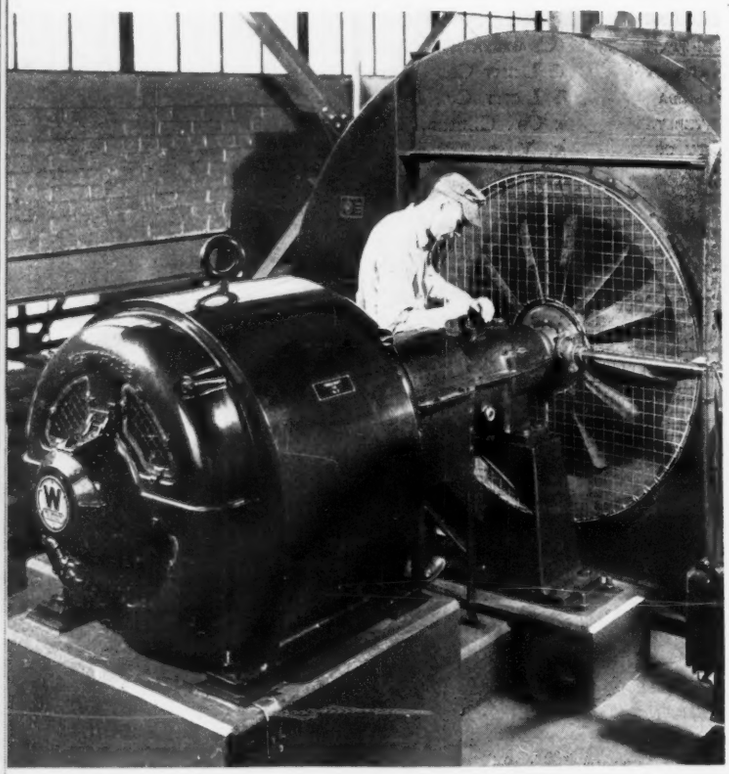
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

before purchasing Boiler or Fuel Burning Equipment

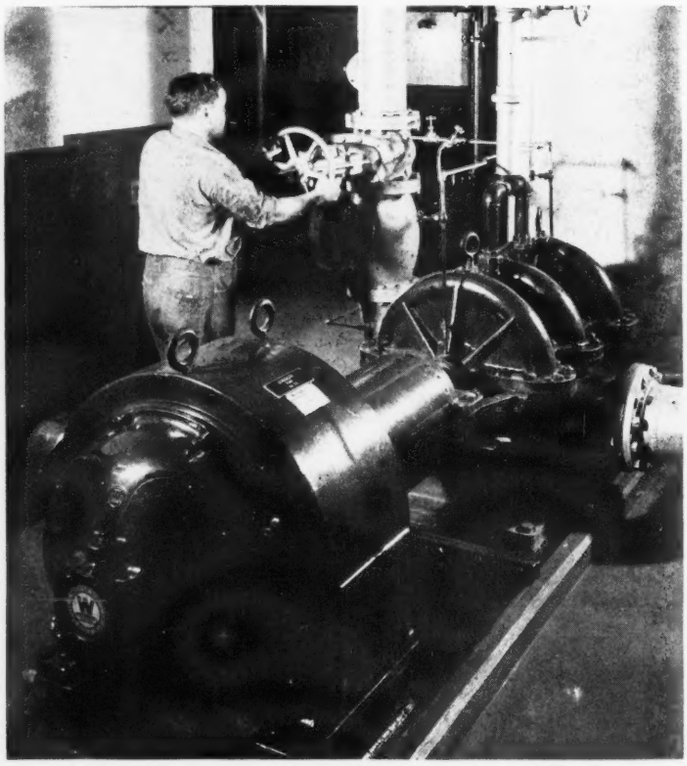
Toronto Adds 35,000 Kw

This picture spread of a recent capacity addition to the Toronto Station of Ohio Edison illustrates the trend of the past few years to better-looking power-station interiors. The day of "gingerbread" construction has been supplanted by neatness that spells efficiency

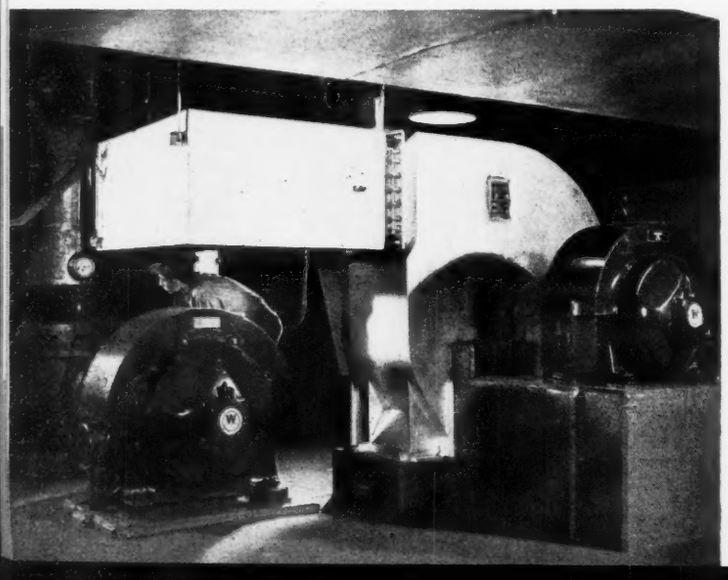
300-hp, 1200-rpm, 2300-volt, Westinghouse induction motor drives Sturtevant inlet-vane-controlled forced-draft fan actuated by the combustion-control system



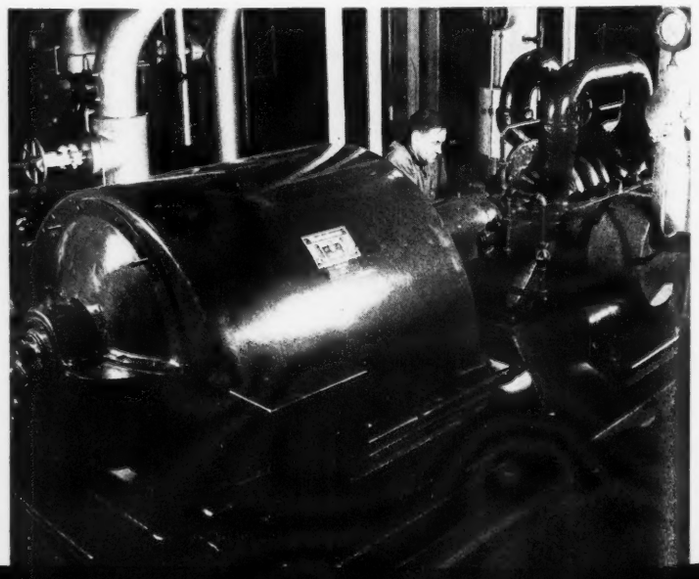
An operator regulates the valves on one of two 3-stage condensate pumps driven by a 75-hp, 900-rpm, 440-volt, squirrel-cage induction motor

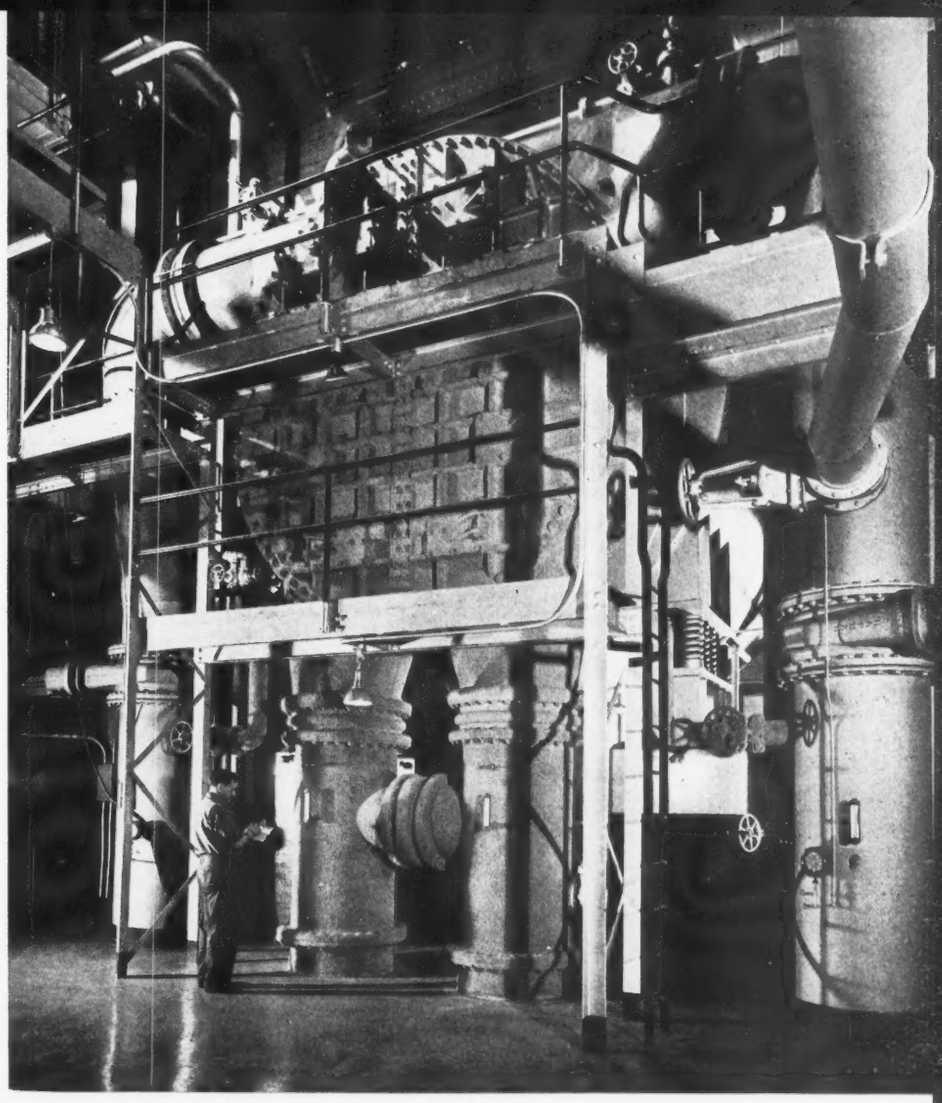


Pulverizer blower unit. The mill is driven by a 75-hp, 600-rpm, 440-volt, squirrel-cage Westinghouse motor; the Clarage blower by a 60-hp, 1800-rpm, 440-volt machine



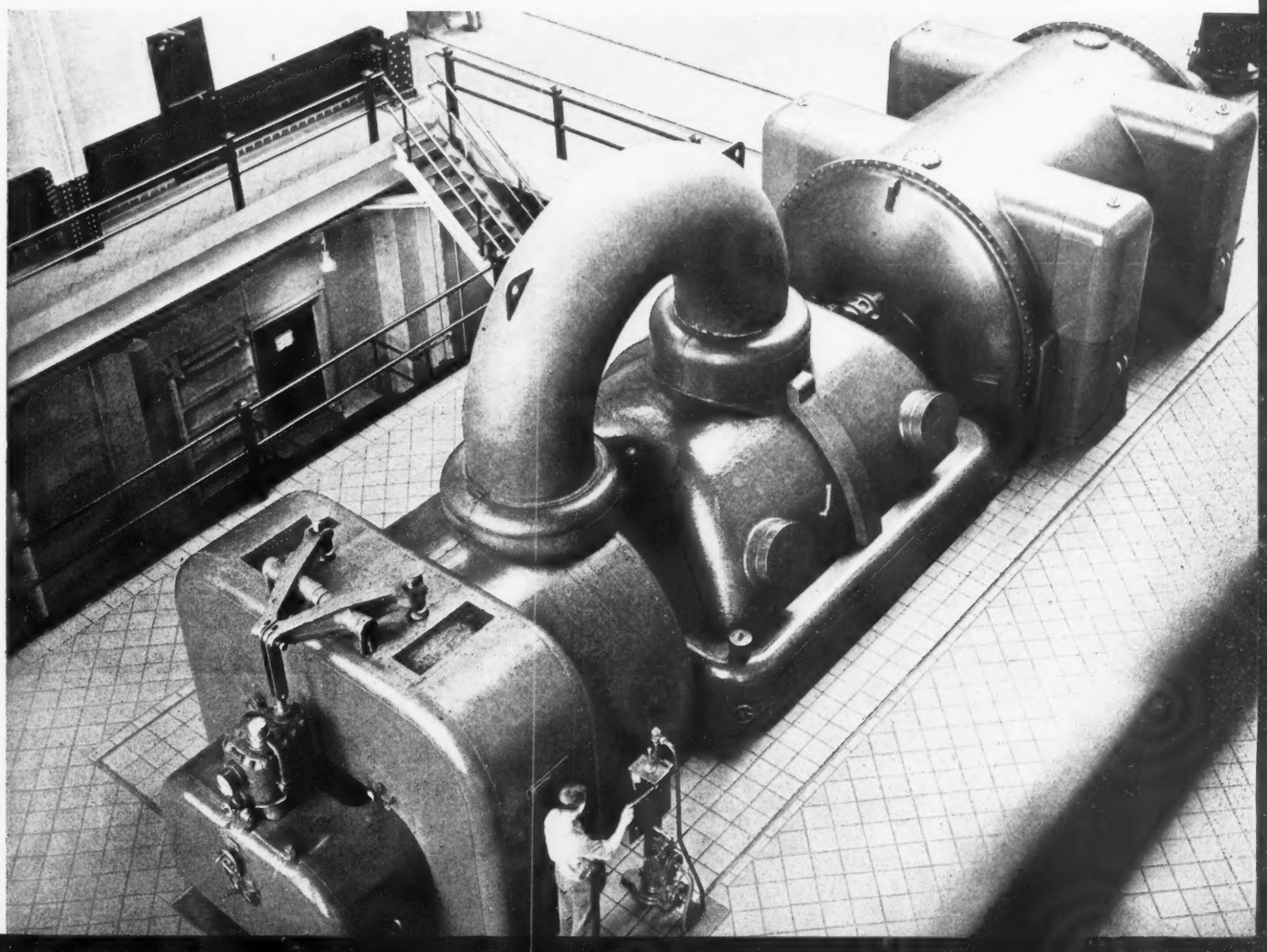
One of the two Worthington boiler-feed pumps, essential auxiliaries to the turbine-generator. Each pump is driven by a 800-hp, 3600-rpm, 2300-volt, squirrel-cage induction motor





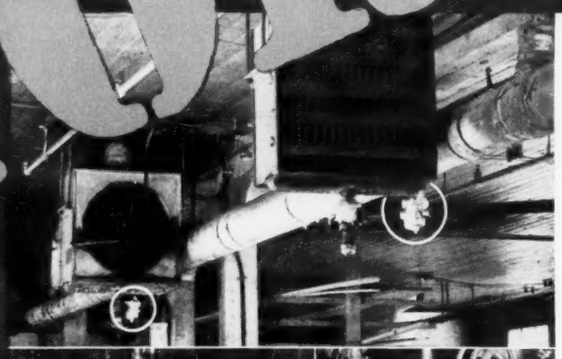
Two operators check performance of 2-pass, radial-flow, flexibly mounted surface condenser with total surface area of 33,220 sq ft

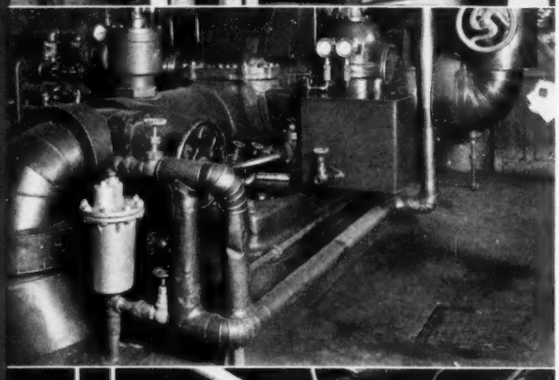
In operation slightly over a year, this 35,000-kw Westinghouse turbine-generator is rated 3600-rpm, 11,500 volts, 43,750 kva, 80% pf, 3 phase, 60 cycles. Steam conditions are 800 lb, 850 F

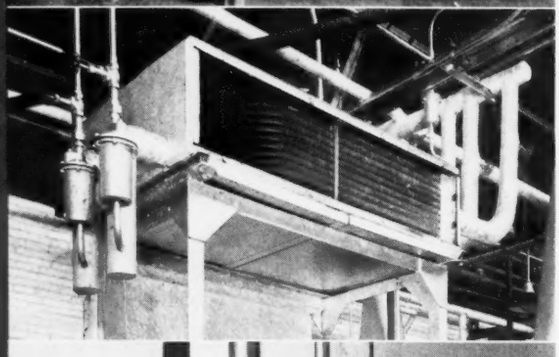


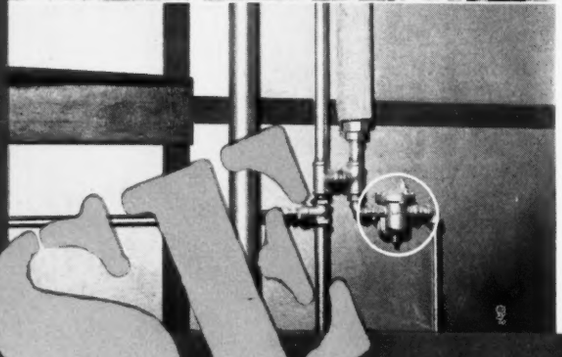
BETTER HEATING SERVICE

FOR:









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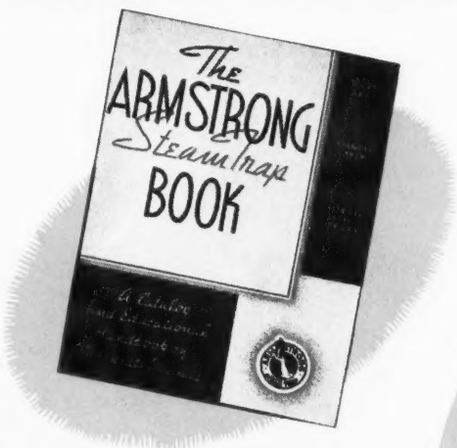

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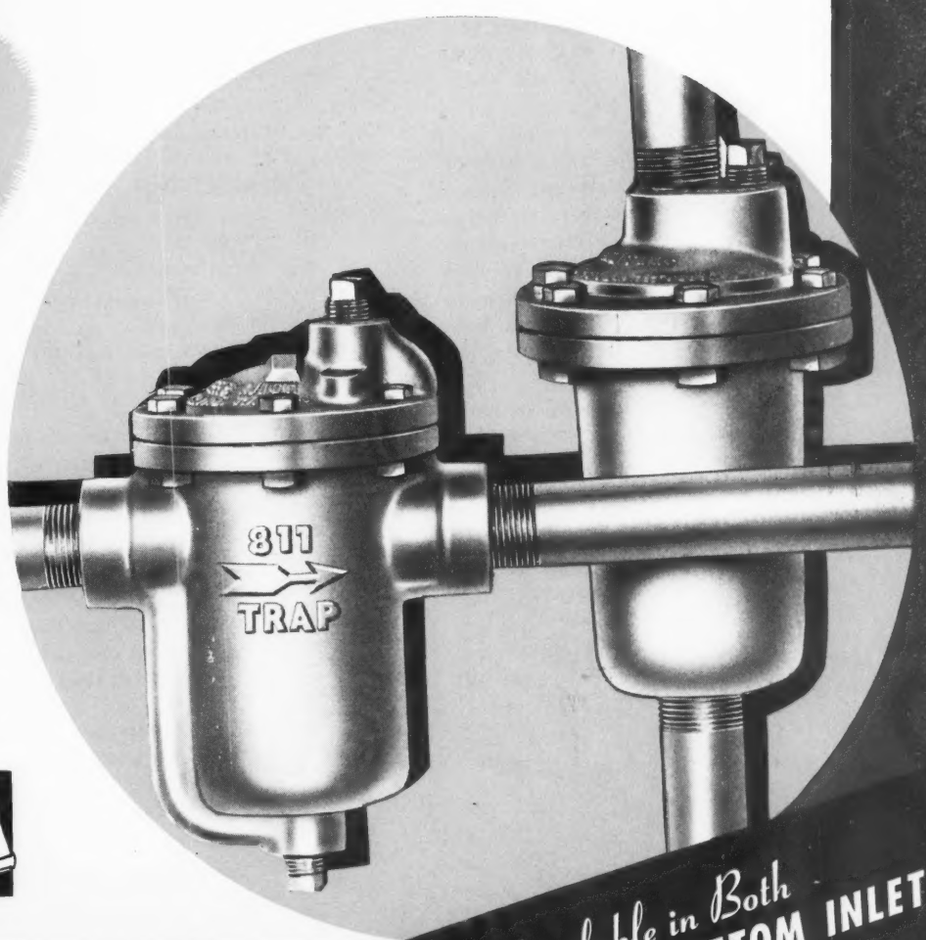

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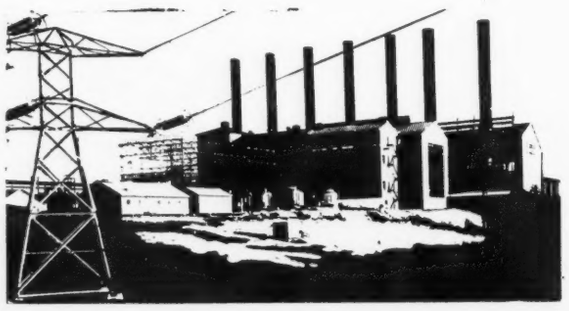
SIDE INLET or BOTTOM INLET
Styles

DEFENSE DIGEST

Trends, troubles, achievements, shortcomings, gossip and sidelights of the National Defense Program, with particular reference to industry's job of production, in which the power engineer is a key man



Aluminum can play tricks with power supply because it takes 10 to 12 kwhr to produce one lb from the ore. The hitch is that an aluminum-ore reduction plant can be installed in 6 to 12 months, whereas it takes from 18 to 30 months to build a power plant to serve it. That's why the national power situation could be unbalanced at any moment by a single false stroke of some planner's pen—spotting new aluminum producing capacity where the power wasn't available.

So far such slips have been avoided, but a strange byproduct of the aluminum situation is a sudden sellers' market for power that was going begging a little while ago in the Pacific Northwest. By the time this issue is off the press, the first of several 108,000-kw generators ordered for Grand Coulee should be in operation, supplementing Bonneville power. Both of these great hydro plants are on the Columbia River, and most of the aluminum plants served will be concentrated in the vicinity of Portland, Spokane and Tacoma. By June 1942, when this development will be in full blast, aluminum capacity of the Northwest will be 400,000,000 lb per year.

OPM is working hard to spread subcontracting, and much progress has been made through the intensive efforts of its Defense Contract Service. Yet there is still vast room for improvement and millions of idle machine hours that could be salvaged for defense production if the human factor could be straightened out. At this point labor may help. Production of certain types of consumer goods has already slowed down for lack of raw materials. That throws men out of work and creates labor pressure for those plants to get busy again with defense contracts.

However the big headache of non-defense production is not at the factory end. In general, industrial workers can find a job somewhere and the manufacturer who cannot make his usual product can find something else to do. Not so with those whose jobs depend on selling those types of consumer goods whose production must be reduced to conserve men and materials for defense. That's why dealers in household refrigerators, washing machines, radio sets and automobiles may be in for tough sledding.

Civilian consumers are beginning to feel the shortage of certain materials. For example, if you started to build a house today you would probably encounter difficulties in purchasing brass or bronze hardware, copper gutters, brass or copper piping. In general the situation is very tight with copper, zinc, brass, aluminum and magnesium—also with certain types and forms of steel.

Scarce defense materials, in most cases, are going in ample quantity to prime contractors on defense jobs and to those sub-contractors who can prove that the material will eventually reach a defense project.

But, as always in an emergency, difficult and unexpected problems pop up and require immediate attention. Take the case of the manufacturer who normally produces for stock—a manufacturer of brass machine screws, for example. He can't start his screw machines every time he gets an order for a gross. He must work ahead and accumulate stock on his shelves, and must therefore consume brass rod—a very scarce article.

How can he get priority for his rod when no one can prove in advance where the screws will go? OPM is attempting to solve this problem by having the manufacturer get affidavits from his customers showing what fraction of previous sales was used for defense products. His future priority on brass rod will depend on the result of this survey. Unfortunately it has proved very difficult for manufacturers to get such affidavits from their customers, who fail to realize that their carelessness in this respect may leave them short of materials later.

The painful tax news is pretty well out of the bag. Everybody is going to pay a lot more taxes in 1942. Despite this enormous tax burden, borrowing for defense will be increasing the national debt at a terrific rate. And now, pay for those in Army service has been boosted $10 a month, which means $180,000,000 more annual expense.

September will likely find the whole East Coast in a tight situation as regards both automotive gasoline and fuel oil. Many plants in the East will shift from oil to coal. It seems likely that more governmental pressure will be placed on the gasoline users than the oil users, because the former are in a better position to economize by eliminating unnecessary use.

Practical Aids to Defense

IN PLANNING this September issue, the editors saw the need to get down to brass tacks. When all is said and done, the average power engineer will serve his country best in this emergency on his everyday job of operation and maintenance. If he needs additional capacity, and can get it, he will put it in—but in any case he will treat his present equipment with practical intelligence. He will do everything humanly possible to keep up steam and voltage to power the machines that serve defense.

With a desire to share this responsibility, and button up the generalities of power for defense with something every engineer can use in his own plant, we present this section, "Practical Aids to Defense". As the name implies, we have combed the "Practical Aids" department of POWER for several years back, selecting items of outstanding emergency value either for getting out of trouble or avoiding falling into it.

The practical reader will find here 20 pages right down his alley and all attuned to the present situation—how to fix breakdowns, how to avoid them, how to conserve manpower, how to get more out of present equipment. All of these tested ideas have come to us from the power plants of America. We send them out again to help engineers everywhere meet the demands of zero hour.

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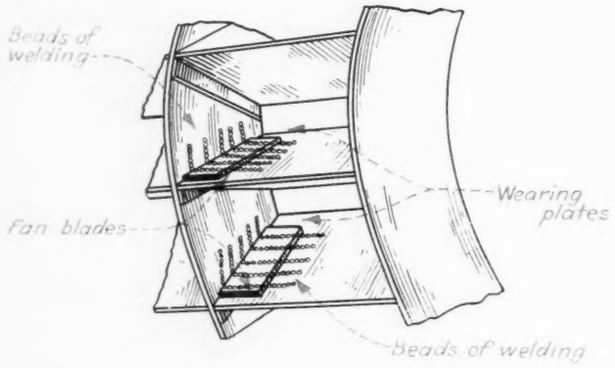
STEAM-GENERATING EQUIPMENT

The power engineer's No. 1 job in defense is to keep steam up. Here are proven experiences out of past emergencies that will help in the days to come

Welding Repairs Eroded Fan Blade



Welding has many uses to increase the life of equipment—particularly important when new equipment or repair parts are hard to get.

Our two high-pressure boilers are fired with raw blast-furnace gas taken directly into the boiler at 340 F and carrying 3.5 grains of dust per cu ft. Flue-gas volume is 50% greater than with coal. High gas velocity, with high dust content, erodes sections of induced-draft fan blades.

Where this erosion occurs we weld on $\frac{3}{8}$-in mild-steel wearing plates, as shown. Over these plates, up the supports between blades and out on the blades, we run welding beads about $\frac{1}{4}$-in. high. These create eddies and help throw dust particles away from blade surfaces and extend life of the wearing plates.

When blades wear out after about nine months service they are easily removed. We then weld in new plates and welding beads. ——*A H Cuzner, Sydney, N. S.*

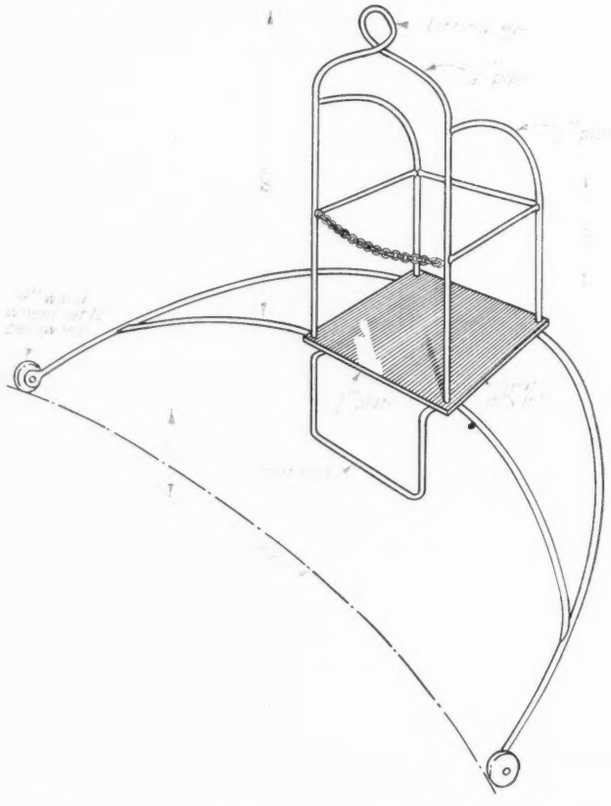
Locomotives Supply Temporary Steam

When the boiler plant must be shut down temporarily maybe locomotives will solve the problem as they did last fall for the engineers of the Terminal Railroad Association, St. Louis, when they found that the large stack at the 18th Street Station needed relining. To do this, it was necessary to shut down the plant, which meant another source of steam had to be provided during the shut-down.

This problem was solved by using three locomotives. As very little information was available on the efficiency of locomotives used in this manner, a water-flow meter, steam-flow meter, draft gages, temperature instruments and orsats were installed to provide complete data.

It required 12 days to reline the stack; the locomotives furnished the necessary steam without any trouble and operated at an over-all average efficiency of 74%. Peak demand was 35,000 lb of steam per hour at 155 lb per sq in. Orsat tests at 15-min intervals showed an average of 10.2% CO_2. —— *S D Distelhorst, Philadelphia, Pa.*

Carriage for Stack Work

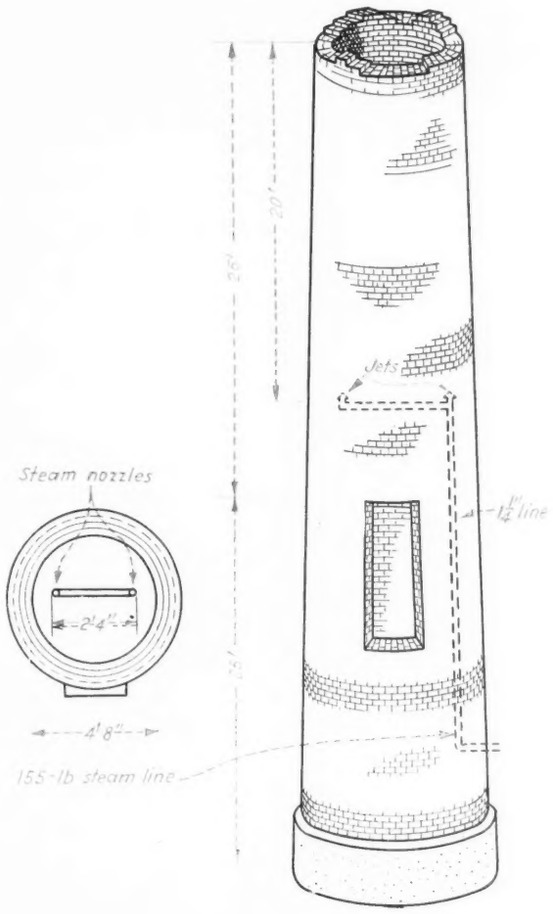


This carriage eliminates costly scaffolding yet insures safety of men sent up stacks to paint and repair.

We made the carriage from $\frac{1}{2}$-in. and $\frac{3}{4}$-in. pipe, with a $\frac{1}{4}$-in. iron plate for a seat assembled by welding. The 4-in. wood wheels run on bearing pins in the ends of the pipe. These ride on the outside of the stack to insure free

movement of the carriage and keep the workmen clear. Note the rest for the workmen's feet and chain to hold him in the seat. The carriage is raised and lowered by a tackle at the top of the stack.

Steam Jets for Damaged Stack



When a hurricane blew 115 ft off our 165-ft power-plant stack, we found a way to keep up steam that might prove useful in other emergencies. We installed in the stack two ½-in. steam nozzles supplied by a 1¼-in. pipe carrying full boiler pressure of 155 lb. Four days after the stack went down, we had the plant operating full load.

Steam costs for jets was considerable, but far less than the shutdown penalty on a mill operating 24 hours per day. If you try this, experiment to find best jet position.

——*Peter F Keough, Fall River, Mass.*

Spares for Defense Loads

Where spares are duplicates of regular units, availability can be pretty well assured by alternate operation—changing from one to the other daily or weekly.

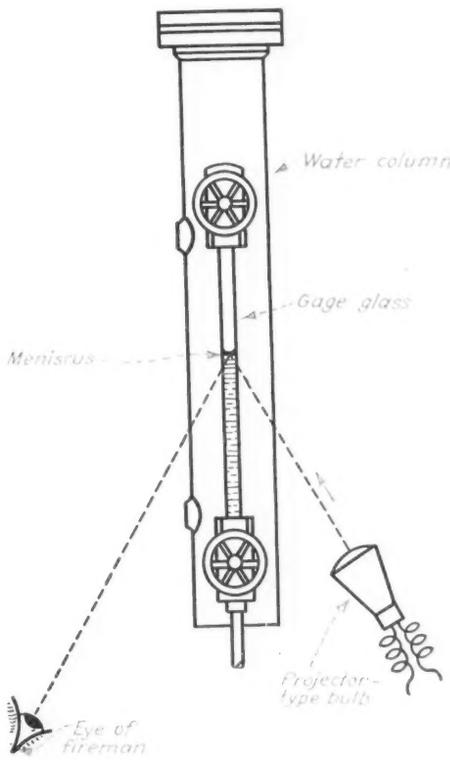
If spares are units of different type, plant economy or ease of control may dictate running the main units continuously. In this case, test spares frequently to be sure they will be ready for service when needed.

In one industrial plant spares are operated or tested according to schedule. The operator responsible for this job fills out a special log sheet. Since testing and equipment change-over is done by one shift during week-end light-load periods, responsibility is fixed. The log sheet enables all to see at a glance whether the work has been completed.

——*S H Coleman, Roanoke, Va.*

Bottom Lighting Spots Water Level

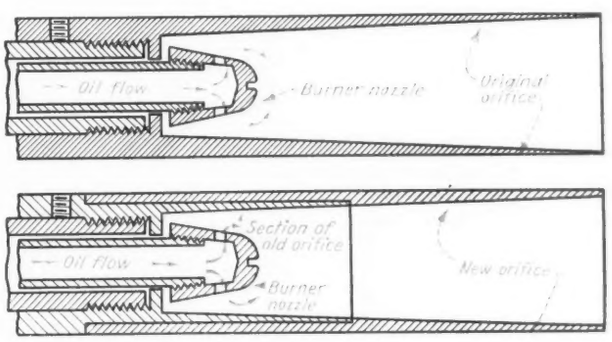
We placed a spot-light below the boiler water level, so that the light rays are projected upward against the meniscus in the water gage glass. The meniscus then acts as a



lens to direct the light down to the observer's eye. The result is striking; a bright band of light seems to float on the water surface in the gage class. For best results use a reflector bulb.——*C A Van Deursen, Battle Creek, Mich.*

Rebuilt Orifices Cure Burner Trouble

On our heating boilers, rotating orifices in the oil burners were short-lived. The temperature was too high at the end of the orifices. Carbon formed on their inside,



making frequent cleaning necessary. The ends of the orifices were thin, Fig. 1, so that they wore out in a month from the frequent cleanings and high temperatures.

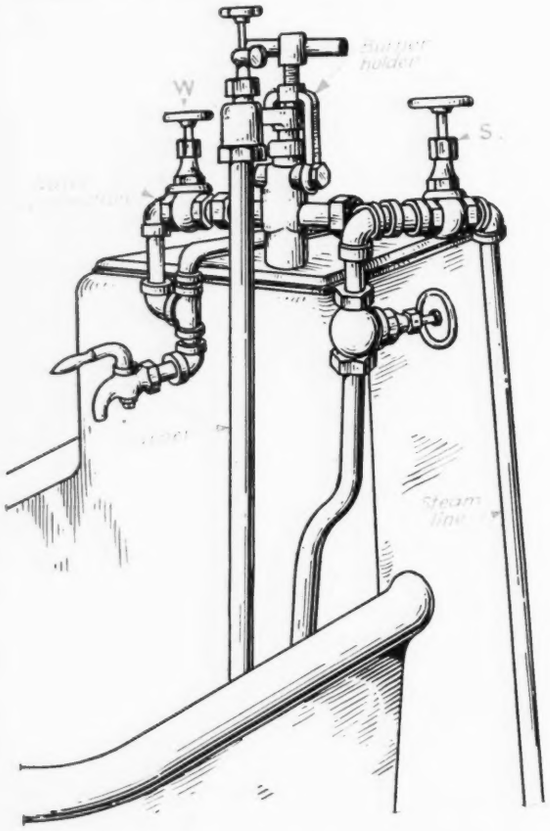
To prolong their life, we decided to make the orifices thicker at their discharge end. Old nozzles were sent to a machine shop and turned to form an inner section, Fig. 2. Then a sleeve was made from a piece of heavy brass pipe to complete each orifice and fitted over the old sections with a press fit. The discharge ends were made about three times as thick as the old ones. These improved orifices are good for a whole season's operation, instead of one month of service from the original design.

Originally the flame impinged upon the sidewalls and caused quite a bit of refractory trouble. Making the discharge end of the orifices thicker has reduced the diameter of the flame somewhat, and the flame is also carried farther into the furnace.

These small changes have eliminated our refractory trouble; boiler and furnace efficiency is at least as good as before the change was made.

——*A Honore, New York, N. Y.*

Oil-Burner Cleaning Rig

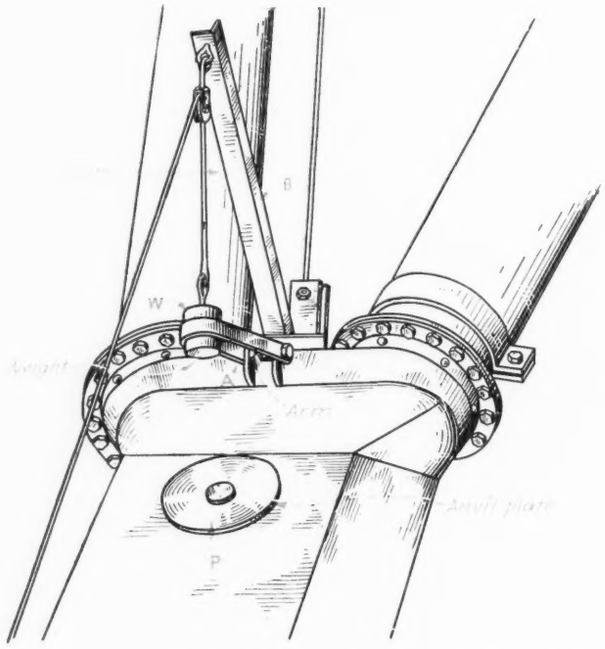


At the New England Confectionery Co plant, Cambridge, Mass., cleaning of mechanical oil burners firing power boilers used to be a problem. Burners had to be cooled, then soaked and scrubbed in kerosene. Then the kerosene had to be wiped off—a dirty, time-wasting job! Now a cleaning fixture, rigged up by chief engineer S Peter Starratt, cleans burners in a couple of minutes with no mess or trouble.

Burner is unclamped from furnace fixture and reclamped in an identical holder, piped for steam and water and set above a slop sink to take the discharge (see figure). Opening valve *S* blows steam through burner, softening grease and blowing out carbon. After about one minute of steam blowing, steam is shut off and water valve *W* is opened. This cools the burner ready for handling—also completes washing.

Inspection of water spray at bottom shows whether burner is clean. If jet is "stringy," burner is given a second blow, first with steam and then with water. This particular rig uses 100-lb steam pressure, but higher or lower pressure will do the trick.

Hammer Loosens Coal in Chute



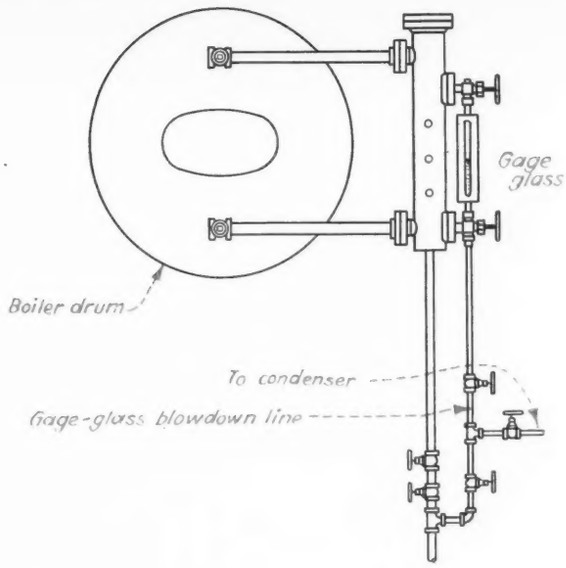
When damp coal hangs up in pulverizer feeding chute, operator merely pulls rope to swing hammer and break jam. Formerly operator had to climb up on scale housing and swing a sledge.

The 20-lb weight, *W*, hangs on arm *A*, attached to chute, and is lifted by rope passing through pulley on boom *B*. Anvil plate *P* protects chute from damage. This device installed on all pulverizing mills at Charles R Huntley Station No. 1 of Niagara-Buffalo Electric Corp rates as a safety kink as well as a labor-saving device.

Vacuum for Emergency Operation

Here's a trick that saved taking a high-pressure boiler off the line. The gasket under a flat-type gage glass began to leak, but we could not replace it because the bottom gage valve was leaking badly.

We ran a pipe connection from the gage-glass blowdown line to the suction line between the inter- and aftercondenser and the main condenser on one of our turbines. By starting an extra set of jets on the inter- and after-



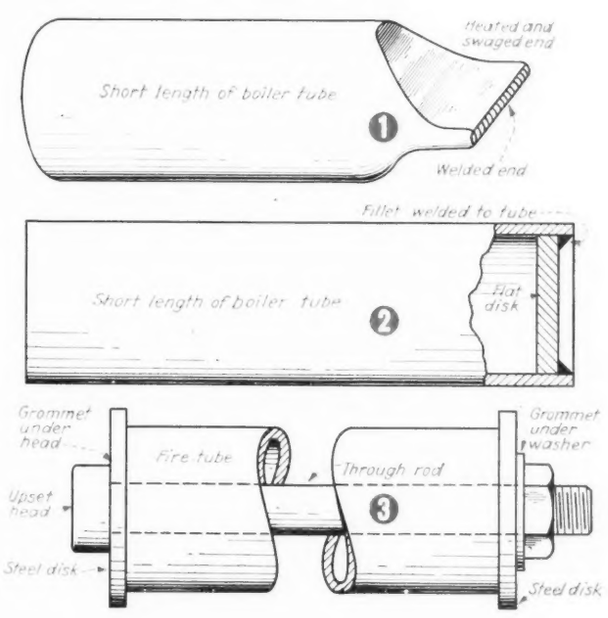
condenser, vacuum loss was slight, and we had no trouble fixing the leak. ——*B Y Buckley, Greenwood, Miss.*

Stub Tubes Keep Boilers Working

Tube failure means a boiler shut-down (and perhaps a complete plant shut-down) unless the engineer can get a new tube or make some temporary repair. Today, the latter is often necessary; Figs. 1 and 2 show two ways.

Remove the defective tube and make sure that no other damage has occurred in the boiler. Then blank off the two tube holes with stub tubes sealed as indicated. The stubs can be cut from the defective tube (not to include the defect) and should be long enough to allow use of the tube expander.

The disk of fire-box-grade boiler plate should be at least $\frac{1}{2}$-in. thick for 250-lb pressure or less, 0.6-in. thick from 250 to 500 lb and 1-in. thick from 500 to 1400 lb. These thicknesses are for a 4-in. diameter tube, and may be reduced slightly for smaller tubes.



Such repairs are not recommended where the stub end is exposed to the direct radiant heat of the fire. Consider such repairs merely as a "crutch" to carry the boiler until a new tube can be installed.

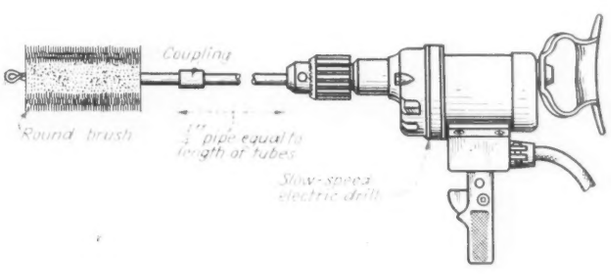
Fig. 3 shows how to stop off both ends of a defective tube without removing tube. This is for firetube boilers only. The end disks shown are $\frac{1}{2}$-in. thick and $\frac{3}{4}$-in. larger in diameter than the boiler tube. They are drilled 17/32-in. to pass a $\frac{3}{4}$-in. round steel rod.

This type of emergency repair should not be used for more than a month or two: the tube will be filled with water (from the defect) so that the rod will be corroded gradually. In time this might lead to rod failure and serious accident.

Operators sometimes plug defective tubes by driving tapered wood or metal plugs into both ends, with a sledge. Even as a temporary repair, this method may be dangerous. If a plug blows out, the sudden release of pressure may collapse the tube.——*R O Billings, Springfield, Mass.*

Electric Drill Cleans Boilers

To clean boiler tubes internally (both fire and water-tube) we no longer push a brush through the tube but connect it to a slow-speed electric drill by a section of



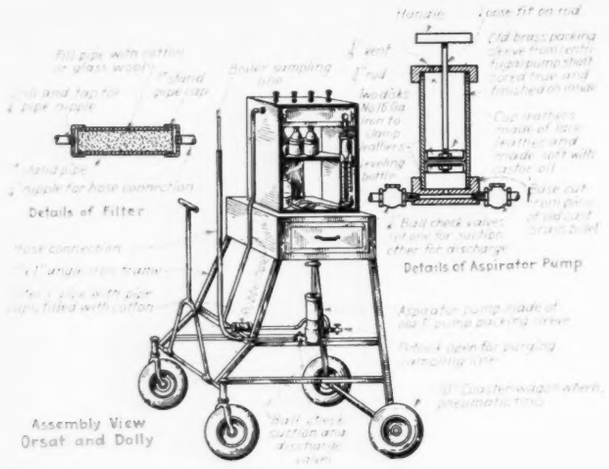
$\frac{1}{4}$-in. pipe of suitable length. Rotating brushes push through from one end to the other. In some cases we put a small universal joint in the middle of a $\frac{1}{2}$-in. pipe to make it easy to handle.——*R Boettinger, Englewood, N. J.*

Orsat on Wheels Speeds Boiler Tests

Put to work, the orsat (hand gas-analysis apparatus) will help many a plant carry defense loads with maximum boiler efficiency. The trouble is that an orsat is inconvenient to lug around by hand. On the other hand, long sampling line gives trouble, chokes up, causes errors.

The answer is to put the orsat on wheels and equip it with a man-size pump to speed up time-wasting preliminaries.

The pump illustrated came mostly from the scrap pile. The cylinder started life as a bronze pump-sleeve. The ends of a cast-brass billet became cylinder heads after a bit of machine work. Base head has two holes bored radially for suction and discharge ports. They enter an axial hole bored only part way through. Suction and discharge-valves are $\frac{1}{4}$-in. brass low-pressure check valves attached to the base head with all-thread nipples. The filter is a 4-in. piece of 1-in. pipe filled with cotton and



capped. A plug cock ahead of the orsat serves as a vent when the sampling line is to be purged.

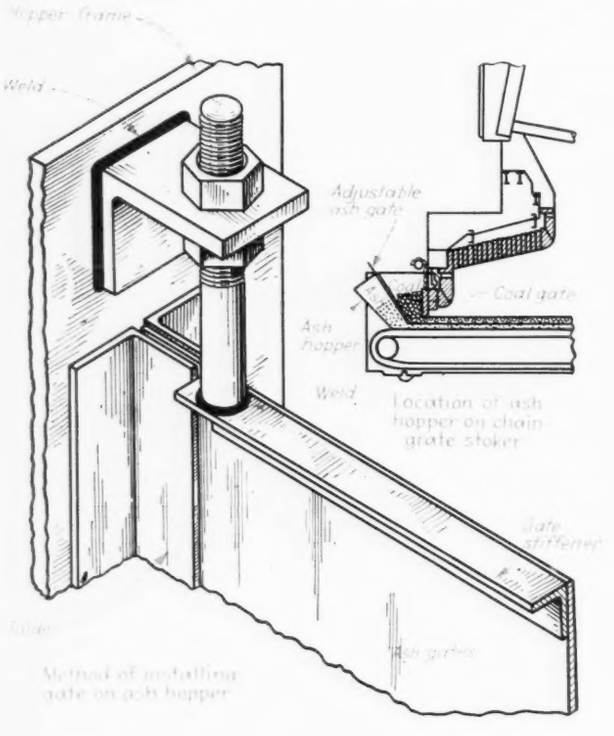
For convenient use, the dolly should be several inches taller than the average table. Pump and accessories should be conveniently placed. Provide a place for pencil, paper and data board. It's smart to caster two of the wheels so the dolly will go where the pusher wishes.

——*H M Naylor, Tecumseh, Kan.*

Feeding Ash Protects Chain Grates

Experience shows that chain-grate stokers work best with high-ash coals, as ash protects grates from burning and so keeps maintenance down. For this reason, many operators of chain grates pass up real coal bargains because ash content is too low. However, such coal can be burned satisfactorily on chain grates—here's the way one plant does it.

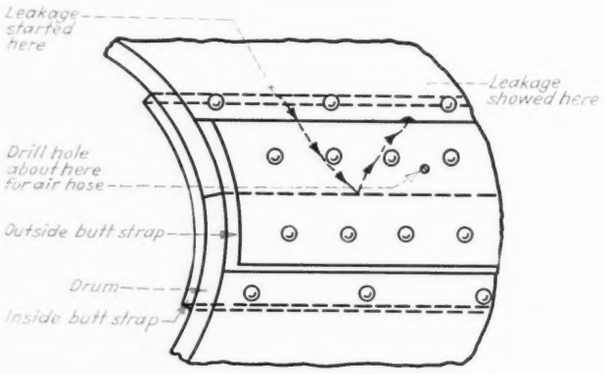
The secret lies in a second hopper and gate in front of the regular coal hopper as in the diagram, arranged to spread a layer of ash 1 to 3 in. thick directly on the grate under the coal. Ash keeps grates cool, with no buckling, which all adds up to low maintenance. Once operator finds right depth of ash layer, he rarely needs to change setting of ash gate and so doesn't need more flexible gate control. Making ash hoppers narrower than grates, by about 6 in. on each side, prevents forming clinkers at side-walls.



Shoveling siftings directly to ash hoppers meets part of ash needs but rest comes from overhead bunker. A partition divides ash from coal.

——*Roy M Garrett, New York, N. Y.*

Compressed Air Traces Boiler Leaks



It is often difficult to trace initial source of leakage on a riveted seam, especially so in the case of butt-and-double-strap-riveted boiler seams. Here's a way to do it with air.

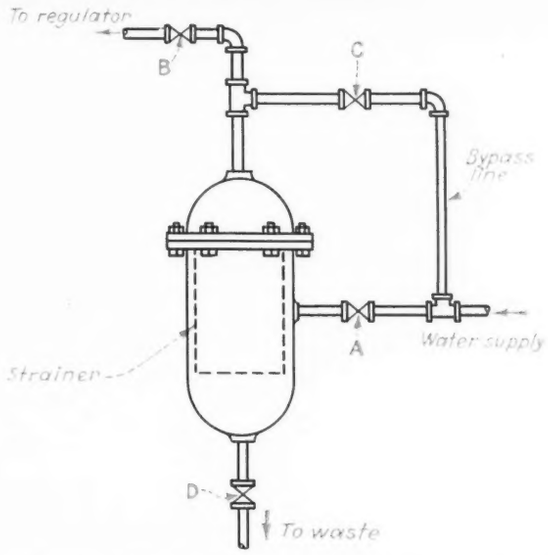
First caulk the outside butt strap tight against hydrostatic pressure. Then at a point near the affected area, and about midway between the caulking edge and the abutting drum edges underneath, drill a 5/16-in. hole through the outside butt strap and thread with $\frac{1}{8}$-in. pipe tap. Screw in a piece of $\frac{1}{8}$-in. tubing and supply air at 30 to 50 lb. While air pressure is maintained a man enters the drum and paints the caulking edges of the butt strap with soap suds. Bubbles indicate whether recaulking is needed. Compressed air pressure should be released during the caulking operations.——*R O Billings, Springfield, Mass.*

Handy Maintenance Aid

Penetrating oil should be in every maintenance kit. It can be used to free nuts and other close-fitting parts subject to the heat. Apply at strategic points immediately after equipment has been removed from service, so the oil can do its work during the cooling-off period. This will make disassembling easy.

Applied to cool parts, penetrating oil should be given time to enter the joints and is most effective when used at least 12 hours before starting work. For applications of this nature, where there is little chance of the oil catching fire, mixtures containing volatile solvents can usually be employed with safety. ——*S H Coleman, Roanoke, Va.*

Bypass Helps Clean Strainer



Strainers installed to prevent trouble can make a lot of trouble. The water line to a combustion regulator on our boilers required frequent dismantling for cleaning. A bypass installed around the strainer to reverse the flow through the screen has reduced regular outage time.

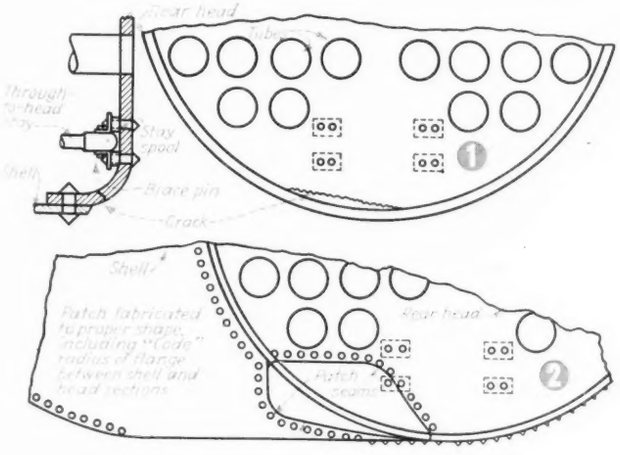
Now when the strainer becomes fouled the regulator is removed from service for a minute or two, valves *A* and *B* are closed and *C* and *D* opened. When the screen has been thoroughly flushed the valves are restored to their normal position. ——*C R Anderson, Richmond, Va.*

Repair for Cracked Boiler Head

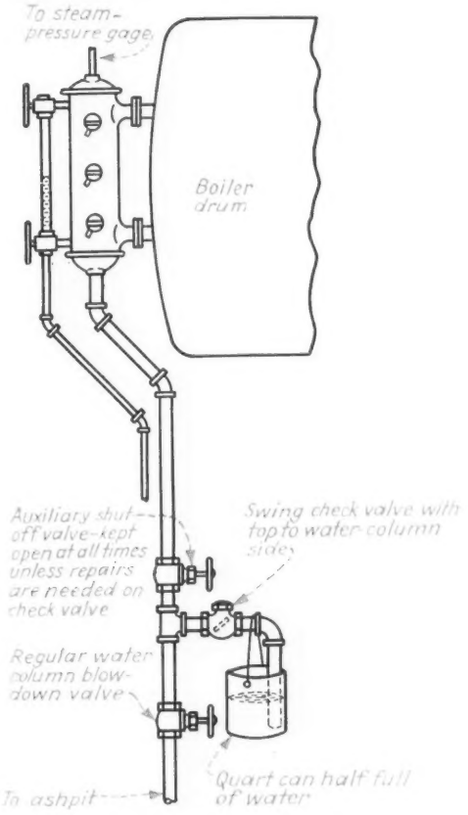
The lower part of the rear head on our hrt boiler cracked, see Fig. 1. As repairs by welding were not permitted by state boiler rules, we tried another stunt.

First, we cut out the defective section in the shape of a triangle, with the intention of installing a riveted patch overlapping the inside of the head and attached to the shell by new head-seam rivets. When head-seam rivets were removed, we found that the shell end had been overheated and rivet holes badly distorted, so we cut back the shell to remove the defective part of the head seam. It was important not to cut back too far or the angle of the patch seam would deviate too far from the direction of the head seam, which would produce a weakening effect.

Fig. 2 shows the completed patch. No indications of leakage or defects developed. A final seal weld applied to the caulking edges provided additional insurance against leakage. ——*H M Spring, Canton, Mass.*



Vacuum Breaker on Boiler


To steam-pressure gage
Boiler drum
Auxiliary shut-off valve—kept open at all times unless repairs are needed on check valve
Swing check valve with top to water-column side
Regular water column blow-down valve
To ashpit
Quart can half full of water

This vacuum breaker eliminates one source of annoyance and possible shutdown. Our boiler, normally operated at 150 lb, is shut down for week-ends. The fireman was supposed to maintain 25 lb, but sometimes grew neglectful, so that the boiler cooled and produced partial vacuum. This tended to cause handhole cover leaks.

The operation of the vacuum breaker will be clear from the bottom of the sketch. The quart can of water serves two purposes. (1) If the check valve leaks the can fills with water. (2) If the watchman allows the boiler to cool off, water will be drawn out of the can into the boiler, indicating the watchman's negligence.

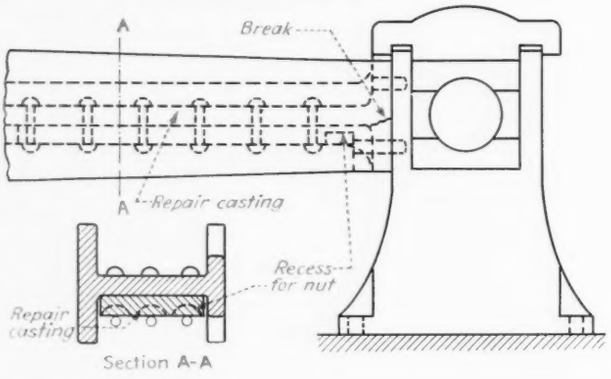
Coal-Tower Maintenance Cut

A gas company was spending $1000 a year to maintain a brake wheel and brake on the grab-bucket hoist of its coal tower. This was an electric brake operated 4 to 6 times per minute. To improve service and reduce repair costs the company installed a new brake wheel of molybdenum cast-iron and a thrustor (electric-hydraulic) brake at a cost of $500. Repair costs have dropped from $1000 to $50 a year. ——*A P Danz, New York, N. Y.*

PRIME MOVERS

When something goes wrong with a turbine or engine and the doctor is out of town, cures like these are worth their weight in gold to keep power flowing to production machines

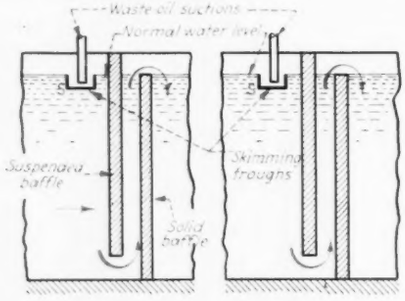
Quick Engine-Frame Repair



On the high-pressure side of our cross-compound engine, the main pillow block worked loose on its foundation. As we were running 24 hours a day, we couldn't shut down to tighten the block. Finally, the under flange cracked off and the engine was pulled off the line in a big hurry.

By riveting a heavy steel casting to the under side of the frame we got the engine back to work in short order. This casting was flanged to fit the broken one and recessed to permit using the bolts in their original holes. While the repair was being made, we secured the bearing pedestal to the foundation. —*C O Hagen, Butte, Mont.*

Skimming Pool Improves Cooling-Tower



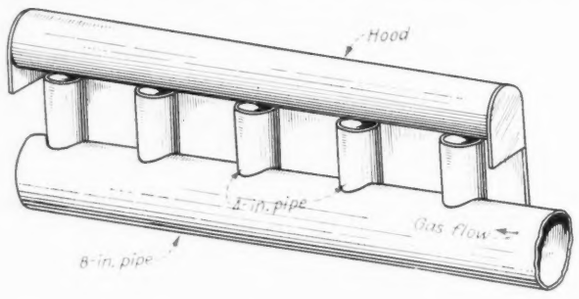
At the plant of the Talco Asphalt & Refining Co, Mt Pleasant, Texas, an oil-skimming pit insures clean water. The concrete pit, 12 ft deep, is divided by vertical baffles into four sections. The baffles are built integral with the pit itself, preventing longitudinal collapse as well as skimming oil off the water before it goes to the tower.

All water enters the pit at one end and flows slowly toward the first suspended baffle. This wall directs flow downward to the bottom where the water is reversed by the floor-supported baffle and flows upward and over its top into the second section, and so on into the fourth section of the pit. From here the clear water is pumped over the cooling tower before being recirculated through the plant.

Channel-form skimming troughs *S* hung just ahead of the suspended baffles are set so that current action will carry the oil from the surface into the channel section, from where it is pumped out and disposed of in a waste pit. When oil is being pumped out, the skimming troughs are raised slightly above the water surface.

—*Elton Sterrett, Longview, Texas*

Multiple Muffler Reduces Exhaust Noise



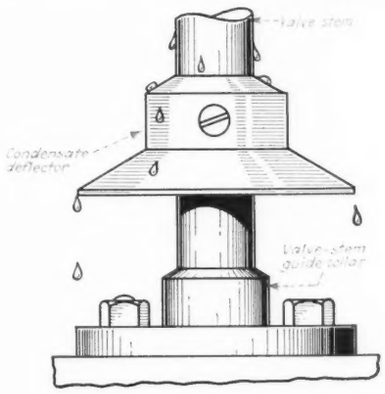
We have muffled two 150-hp, 2-cyl gas engines without creating objectionable backpressure or requiring an elaborate outlay. We cut off the 8-in. underground exhaust line, where a 45-deg surface pipe was welded to it, and extended the line into a small concrete sump pit, with provision for carrying away any condensation that might occur.

After blanking off the end of the 8-in. pipe, we welded five 4-in. stub pipes into its upper surface. A semi-cylindrical hood, formed from splitting a piece of 8-in. pipe, was then supported over these stubs by a plate welded along one side of the pipe, with two stiffener plates at the ends.

Now exhaust impulses traveling along the 8-in. pipe lose part of their gases at each succeeding upright stub,

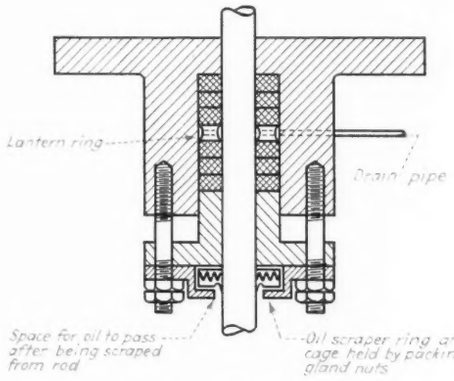
are then turned through 90 deg and come from under the curved edge of the hood in a downward direction, in what amounts practically to a steady flow of exhaust gas. *—M T Pate, Longview, Texas*

Guard Keeps Water Out of Crankcase



When condensate ran down the valve stem of a vertical engine onto the crankcase guide collar and into the lubricating oil, I rigged a tight-fitting guard for the valve stem. This diverts the condensate away from the lower end of the valve stem and we no longer have contaminated oil. *—S M Elonka, New York, N. Y.*

Piston-Rod Scraper Stops Oil Leakage


Lantern ring
Drain pipe
Space for oil to pass after being scraped from rod
Oil scraper ring and cage held by packing gland nuts

Two vertical closed-crankcase engines required considerable makeup oil to maintain proper level in their cases. The diagram shows a cross-section through one of the piston-rod packing boxes of these engines. The top three rings of packing prevent steam leakage from the cylinder and the lower three keep any cylinder condensate from entering the crankcase. A metal lantern ring between the two sets of packing rings permits draining away condensate from the cylinder and oil that comes up from the crankcase through the packing.

Oil leakage into the lantern ring was excessive and flowed out through the drain pipe with the condensate. Various types of soft and semi-metallic packing were tried without success. We then purchased a sectional metal scraper ring with garter spring and made a cage for it from steel plate. This cage was fastened under the gland nuts to hold the scraper around the shaft.

—R E Fontaine, Buffalo, N. Y.

Troublesome Turbine Vibration Cured

A 2000-kw turbine-generator developed a peculiar case of vibration twice a day, between 9 and 10 AM and 2 and 3 PM. Regularity with which the vibration occurred made us suspect that heating and cooling of turbine parts was causing the trouble.

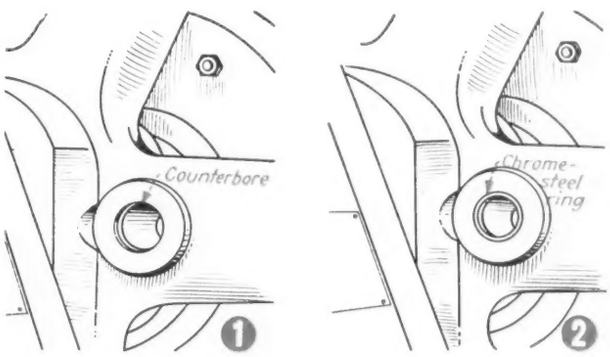
Examination showed that the steam-pipe supports buckled because of expansion and put a twisting action on the turbine-valve casing. Vibration of the turbine gradually worked the pipe through its supports to free the valve casing, then the vibration would stop. When the turbine was shut down at noon and night, contraction of the pipe and turbine pulled the pipe through its supports ready to distort the valve-casing when the turbine was started again. Releasing all the anchors on the pipe and supporting it on rollers stopped the vibration entirely. *—H C Bulsara, Nagpur, India*

Steel Rings Make Unruly Governor Behave

The governor on a 200-kw steam engine failed to give its usual close speed regulation. The inertia bar of the governor was supported on a roller bearing on a pin held in a hole in a flywheel spoke, close to the hub. The sleeve on the pin on which the bearings ran extended beyond the bearing end and acted as a shoulder against which the pin could be tightened without jamming the bearing. We found that this sleeve, only $\frac{1}{8}$ in. thick, had cut into the spoke about $\frac{1}{16}$ in., allowing the pin to wear the hole slightly out of round and causing improper governor action.

To correct the trouble we counterbored the hole $\frac{1}{4}$ in. deep, Fig. 1, into which we pressed a chrome-steel ring with a bore that would make a good fit on the pin. Fig. 2 shows the ring in place. This ring serves the double purpose of truing up the hole and providing a substantial bearing for the pin.

—A L Waterman, Hanover, N. H.



Plugged Nozzle Improves Efficiency

A centrifugal pump driven at 1900 rpm by a 60-hp steam turbine operating on 130-lb steam used 72,800 lb steam daily, as indicated by a steam flowmeter. A pressure gage attached to the turbine side of the governor showed a pressure of 43 lb when turbine throttle, pump

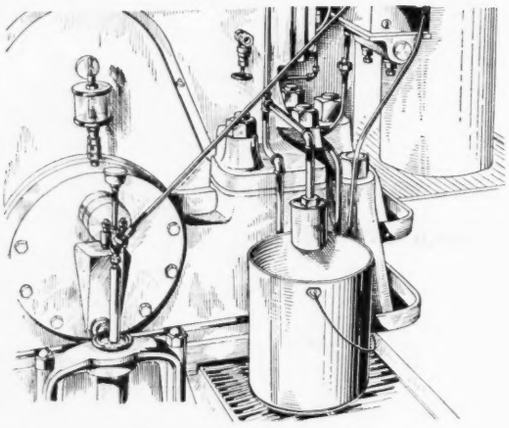
suction and discharge valves were wide open, proving that the turbine was not operating near rated capacity.

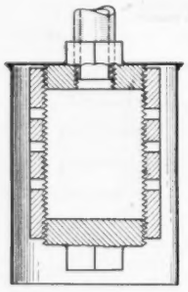
This turbine did not have hand-operated valves for closing some of the nozzles to reduce pressure drop across the governor valve, so we removed the nozzle ring, then tapped and plugged one of the nozzles with a pipe plug. This change increased steam pressure on the turbine side of the governor to 62 lb and reduced daily steam consumption to 63,800 lb.

On turbines, the value of hand-operated nozzle valves can be more readily realized if a pressure gage is connected to the low-pressure side of the governor valve. This makes it possible for the operator to close the proper number of nozzles to maintain constant speed with minimum pressure drop through the governor valve and thus operate at higher efficiency.

—*R E Fontaine, Buffalo, N. Y.*

Easy-to-Make Muffler for Diesel Receiver





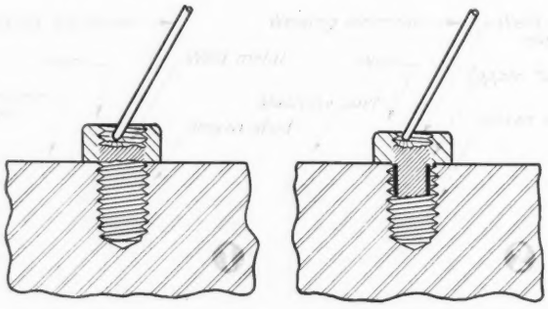
When we blew down the air compressor, cooler, and air bottle on our diesels, the floor always got baptized with heavy slugs of oil which couldn't be caught in a pail. So we made a muffler for the blowoff drain pipe, using a 2-in. pipe coupling, 2 plugs, and a tin can. Fig. 1. We pipe-tapped a hole in one plug to take the blowoff pipe, and drilled ¼-in. holes in the sides of the coupling. Coupling and plugs were assembled as shown.

Using a common garden-variety tin can, we cut a hole in the bottom to fit the nut of the upper plug, cut the top off clean and soldered it on the upper plug. Fig. 2 shows the muffler installed. Now when we blowdown, oil spatters through the holes in the coupling, comes up against the sides of the can, and drips down into the pail.

—*A B Allen, Fernandina, Fla*

Convenient Way to Remove Broken Studs

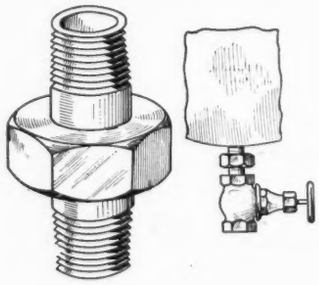
When a stud or cap bolt breaks off in its hole flush with the surface the remaining piece can be removed by welding, see Fig. 1. Take a nut the same size or slightly smaller than the stud and place it around the broken section. Using the smallest available size heavily-coated electrode, weld the nut to the threaded portion of the stud. After welding allow the work to cool and



then tap the nut lightly with a hammer. With a tight-fitting wrench, work the nut right and left until the threads become loose. Then remove the stud.

If the stud has broken down into the threaded hole, it can be removed as in Fig. 2. Fit a copper ferrule snugly into the hole on top of the stud to protect the threads, flush with the top of the hole. Put the nut into position and weld it to the stud; then remove the stud as explained above.—*T B Jefferson, Kansas City, Mo.*

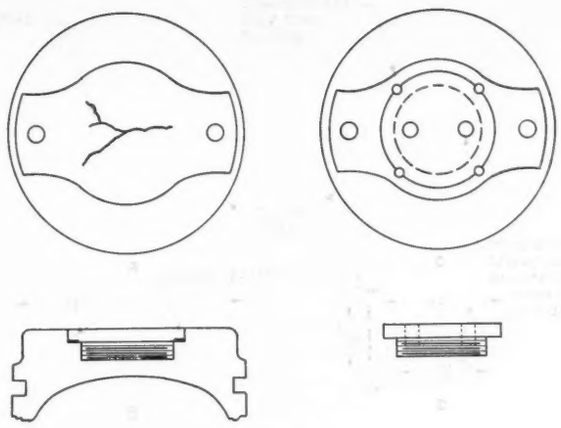
These Drain Nipples Don't Break Off



Trouble with drain nipples breaking off lead me to devise new ones made from standard ¾-in. hexagon brass stock. I turned down this stock in a lathe to proper diameter and threaded it at both ends, leaving a hexagon section in the middle for a nut. The nut permits putting in the nipple or taking it out with an open-end wrench instead of a pipe wrench.—*S M Elonka, New York, N. Y.*

Threaded Plug Repairs Diesel Piston

One of the pistons of a 240-hp, 4-cyl, 2-cycle engine burned and cracked across the top, due to faulty ignition. The cracks can be seen in *A*, while *B* shows how we bored out the head and threaded the hole. We put a shoulder in the hole to protect the threads from burning and to make a better seal, then inserted a copper gasket. When the plug was finished, and before screwing it into



place, we used iron cement generously on the threads for the plug in the head.

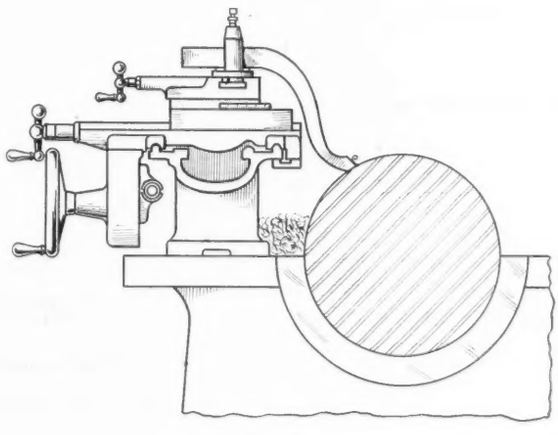
By drilling holes about ½ in. deep into the plug, as shown in *C* and *D*, we got a lever on it for screwing up. Because we weren't sure about the strength of the repair, we put a few dowels around the edge to keep the plug from turning. After several years of service the plug is still in good condition.—*Leslie Bradley, Bismarck, N. D.*

Turbine Shaft Trued by Small Lathe

Bearing surfaces on both ends of a 12,500-kva steam turbine-generator shaft became badly scored. The plant engineer averted a long-time shutdown by using a small bench lathe to remachine the journals without removing the 22-ton shaft assembly from the turbine.

First, turbine bearing caps were removed, then the bed and carriage of a 9-in. lathe were bolted to the turbine frame. Lathe-bed vee-ways were carefully aligned with the shaft. A special goose-neck cutting tool, forged to suit the job, was mounted in the lathe tool post, see figure below.

Operators set up an old hoisting rig driven by a 5-hp motor on the floor and geared it to the turbine to drive the shaft at suitable speed. After starting the turbine shaft, they fed the forged cutting tool along the scored journal surface by turning the lathe carriage handwheel. Result was a smooth finish turned out in short order.
—*N D Jackson, South Bend, Ind.*

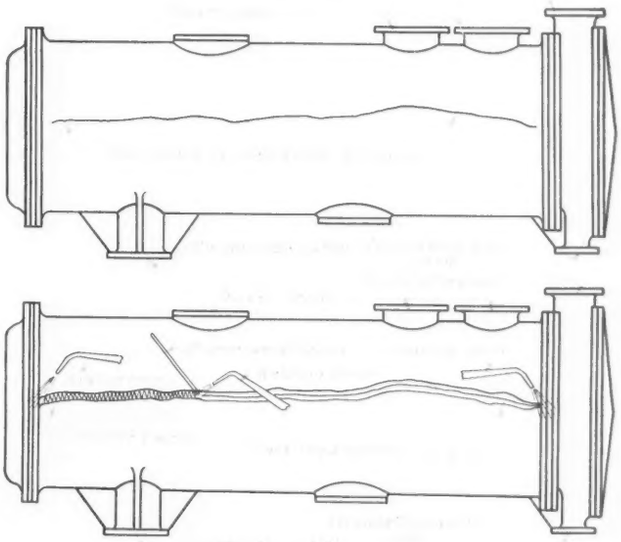


Bronze Welding Cures Leaky Condenser

When a condenser developed an end-to-end crack, we turned to bronze welding for a speedy repair.

First, tubes were removed and the heads replaced on the shell. Then the crack was veed out by chipping, care being taken to keep the bottom of the crack closed as nearly as possible. We then turned steam into the condenser and gradually preheated the shell with low-pressure steam for five hours before starting oxyacetylene welding.

Three torches were used, two for heating the flanges



and the third for welding the crack. We continued preheating by steam until all welding was completed, after which steam was gradually shut off and the shell allowed to cool gradually. After the shell cooled, tubes were replaced and the unit put into service without any signs of air leaks. During 18 months of practically continuous operation under a 28-in. vacuum, the shell has not shown any indication of leaking at the crack, which speaks well for the welding job. —*T B Jefferson, Kansas City, Mo.*

Tight Plugs for Condenser Tubes

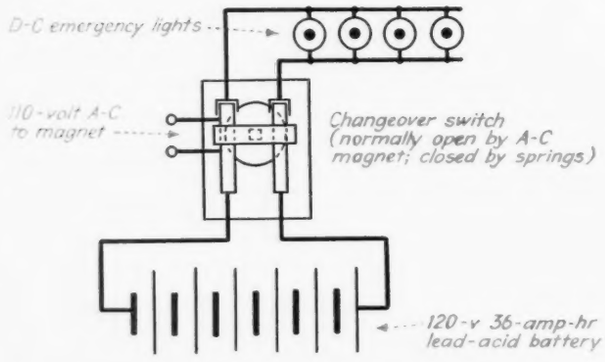
Usual practice when a condenser tube develops a hole is to plug the tube. Wood plugs leak because wood is porous. Because there is no taper in the tapping of a condenser tube sheet, screw plugs, which depend upon thread tightness, frequently leak. Non-ferrous-metal plugs must be driven in by hand, are difficult to remove, and tube holes may be enlarged.

Plugs made from solid fibre have many advantages. They do not damage the tube sheet since a light tap with a hammer drives them into position; they swell in water and make a tight fit in the tube; they are reliable and easy to remove. ——*W M Kennedy, Hoboken, N. J.*

ELECTRICAL EQUIPMENT

When a motor or transformer kicks out unexpectedly, and you're running 24 hours a day, quick repairs like these will save precious hours and speed the battle of production

Emergency Lights from Control Battery


D-C emergency lights
110-volt A-C to magnet
Changeover switch (normally open by A-C magnet; closed by springs)
120-v 36-amp-hr lead-acid battery

Oil lanterns as emergency lights give very little illumination and are inconvenient to handle when the operator must act quickly. Since the circuit breakers in our plant are electrically operated from a 120-volt storage battery, we use this battery as a source of power for an emergency lighting system.

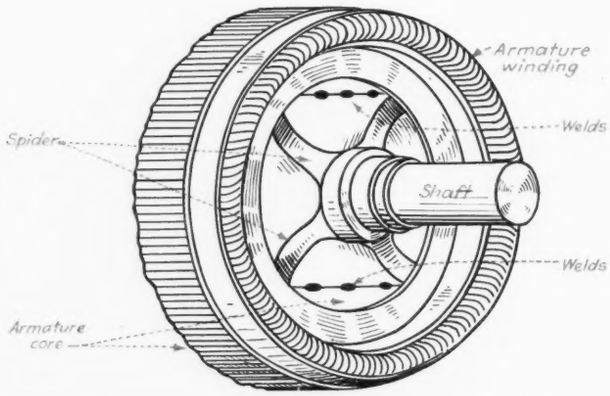
We installed a 100-watt lamp at the 2300-volt disconnect switches, a 100-watt lamp at the boiler-feed pumps, a 50-watt lamp at each boiler control board, and a 25-watt lamp at each boiler water column. An automatic switch on the direct-current circuit between the lighting system and the battery is held open normally by an alternating-current magnet (see diagram). When the alternating-current fails, springs close the switch and put the direct-current lights in service.——*R H Sogard, Columbia, Mo.*

Quick Repair of Armature Core

The core of one of our dc fan motors came loose on its spider; commutator and spider remained tight on the shaft so that the only movement due to looseness was between armature-core and spider arms.

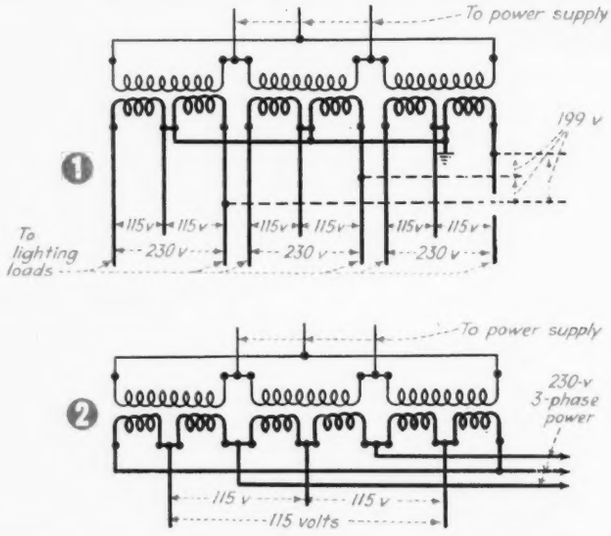
This caused noisy operation and a slight bending action on the armature leads where they connected to the commutator. Welding saved us an expensive time-consuming armature rebuilding job.

A welder deposited light sections of a single electric welding bead in the corners formed by ends of the spider arms and inside of the core, see figure. The beads were made in short sections that filled about 50% of the total



length of the corners. The job was done slowly and carefully in order not to raise core-temperature to where it might damage coil insulation or cause excessive stresses in the armature. ——*Thomas Wood, New York, N. Y.*

Transformer Changes Save Power



We have two ways of cutting power consumption in buildings during light-load summer months. Lighting load in one building is normally supplied by three 50-kva transformers with delta-connected primaries. Secondary of each transformer is arranged for a single-phase,

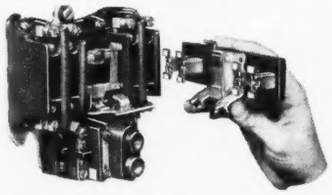
(*Continued on page* 128)

Dad, You're a WONDER *– now it runs like new!*

Tip to Model Railroaders

When your locomotive sparks at the wheels, loses power and doesn't run right, clean your tracks with steel wool. Your tracks, like any other *horizontal* surfaces, collect dust. Dusty, dirty contacts in any electrical system *always* mean trouble.

The knowledge of the importance of clean, dust-free contacts can banish endless trouble in running a model railroad . . . or *in running a man-size factory*. For no matter how small or how BIG the job that electricity is asked to do, clean contacts are a first requirement for faultless, reliable performance. In these days when *dependable* operation *means so much*, you too should insist on dependable dust-safe VERTICAL contact Motor Control . . . by specifying Cutler-Hammer Motor Control and refusing *any* substitutes. CUTLER-HAMMER, Inc., 1358 St. Paul Avenue, Milwaukee, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto.



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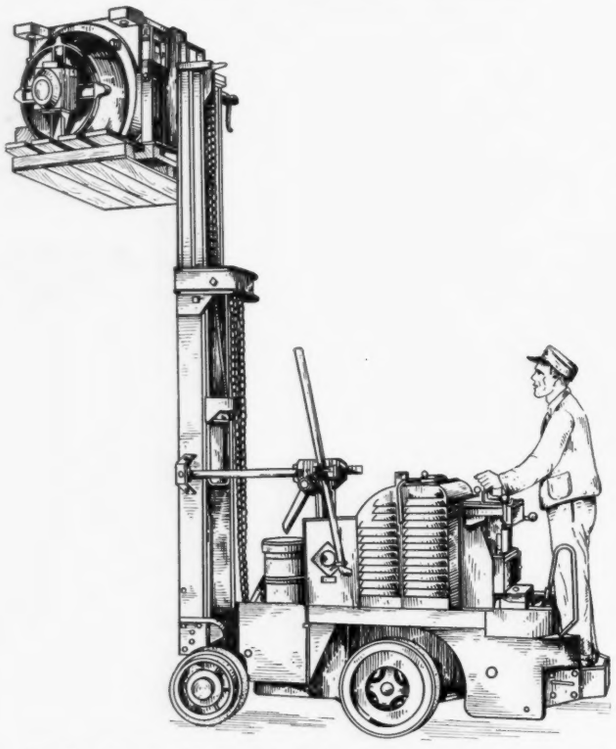
Dust Safe **VERTICAL** *Contacts*

115- to 230-volt, 3-wire system with grounded neutral, full lines, Fig. 1. In winter time, power is provided by three 75-kva transformers connected delta-delta.

To reduce transformer losses at light loads, we connect the power load to the lighting transformers, as indicated by the dotted lines, Fig. 1. This connection is the equivalent of connecting one-half of each secondary winding in star and gives $115 \times 1.732 = 199$ volts 3-phase. We found that the 230-volt motors would operate satisfactorily on this voltage.

In another building, lighting was supplied by three 37.5-kva transformers connected delta-delta for 115 volts on the secondary side, and power by two 75-kva transformers connected open-delta for 230 volts. Here a 10-kva, 3-phase transformer was installed for summer lighting and power loads. Secondaries of this transformer were connected series-delta for 230-volt, 3-phase power. Taps from the center of each secondary give 3 phase for lighting, Fig. 2. ——*A R Markland, Altoona, Pa.*

Easy Way to Ceiling-Mount Motors



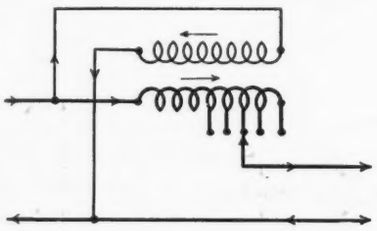
Facing the problem of hoisting large motors into position for bolting upside-down to ceiling stringers, a New England factory solved the problem quickly with one of the standard stacking machines used for handling boxes and bales in warehouses.

Method is obvious from drawing. First, place bolts head up in stringer holes. Motor, mounted upside down in wood cradle on tierer shelf, is raised within 2 or 3 in. of its final position. Next, move tierer until bolts line perfectly with holes in motor base. Finally, raise platform until motor is solid against stringers. Slip on washers and nuts, tighten nuts, and the job is finished safely, quickly and without heavy labor.

Transformer Corrects Lighting Trouble

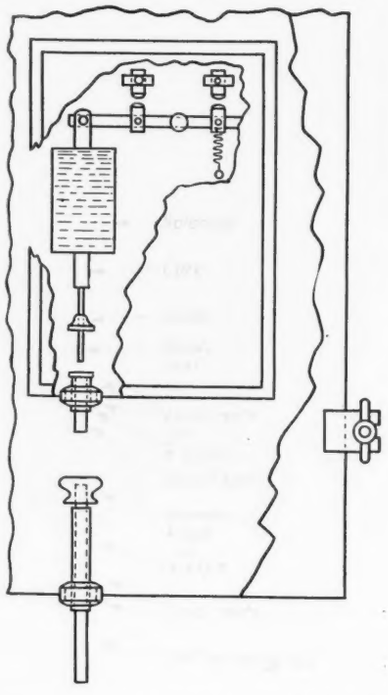
Some types of lamps are quite sensitive to voltage changes, which makes it necessary to hold the potential near rated value at their terminals. We experienced this condition with five 40-watt fluorescent lighting units. When first installed, they had a tendency to flicker. A test with a voltmeter showed only 112 volts at the lamp terminals, where there should have been 120.

To correct this condition, we connected a 50-watt bell-



ringing transformer in the circuit, as in the figure. Using the 8-volt tap on the transformer gave us about 119 volts at the lamps. The transformer does not heat excessively and it is safe to add 3 or 4 more lamps to the circuit if necessary. ——*W T Estlick, Ansonia, Conn.*

Test Keeps Voltage Regulators in Shape



The diagram shows a quick easy test for automatic voltage regulators. Below the guide rod in the solenoid core we inserted a short $\frac{1}{4}$-in. pipe nipple in the regulator case and held it in place by two nuts. In this nipple we put a section of No. 40 nail with the head on top.

Below the nail we put in the outside casing a short section of $\frac{1}{4}$-in. pipe to hold a section of $\frac{3}{16}$-in. welding rod with a wooden knob on its top end. To test the regulator all we do is push up on the end of the welding rod and this motion is carried to the solenoid core by the nail. ——*William Knoll, Jr, Kearney, Neb.*

BIGGEST DIESEL PLANT IN U. S. EQUIPPED WITH • • • *Sylphon* SAFETY CONTROLS

The diesel plant of the Imperial Irrigation District at Brawley, California, developing 18,340 horsepower, is protected against possible failure of lubricating oil pressure or engine overheating.

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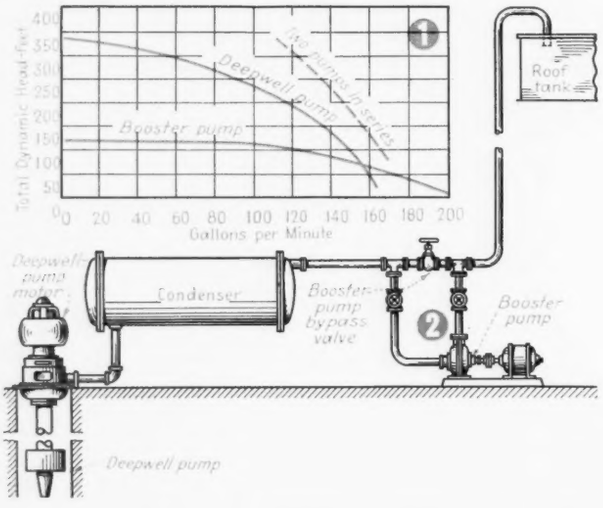
PUMPS, PIPING AND VALVES

Here are experiences out of the plant that will get balky pumps, valves and connecting lines back on the job when every minute counts

Pump Boosts Head and Capacity



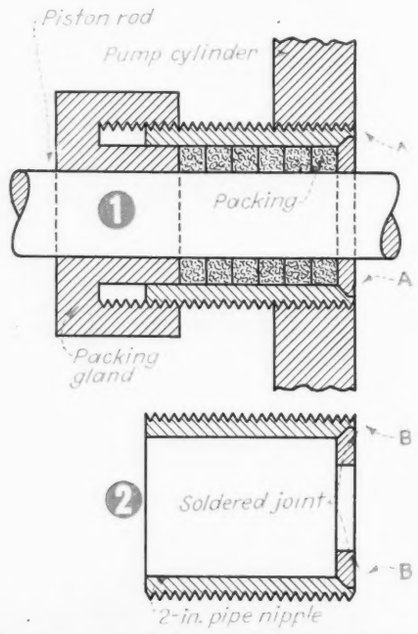
A 100-gpm deepwell turbine pump operating against 250-ft total head, was required by increase in plant size and necessity for improving refrigeration efficiency to turn out 140 gpm. This was done, without any change in the deepwell pump, by installing a booster pump, Fig. 2. When demand is low, bypass valves are closed and deepwell pump discharges directly to roof tanks. When refrigeration demand is at peak, the booster pump goes on.

The curves, Fig. 1, show the capacity characteristic for the deepwell pump alone, booster pump alone, and the two pumps in series. In the latter case, the deepwell pump discharges against 150-ft head only and delivers 140 gpm. The booster pump was selected for a capacity of 140 gpm against 100-ft head; therefore, the two pumps in series deliver the 140 gpm against the 250-ft head as required.

——*F A Kristal, New York, N. Y.*

Quick Repair for Broken Stuffing Box

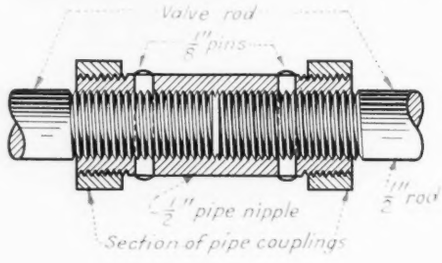
One of our pumps has a brass stuffing box that screws into the cylinder casting, see Fig. 1. One night the watch engineer pulled the packing so tight that he cracked the bottom out of the box at *A*, which remained a ring. Next morning when the stuffing box had been taken out I found that it was the same size as a 2-in. brass-pipe nipple.



To make the repair I shaped the edge of the ring and the end of the nipple as at *B*, Fig. 2. Then I set the ring slightly inside the end of the nipple and peened the end of the nipple over onto the ring to hold it in place. A thorough soldering of the joint completed the job.

——*Alex Gray, Riverdale, N. Y.*

Simple Valve-Rod Repair

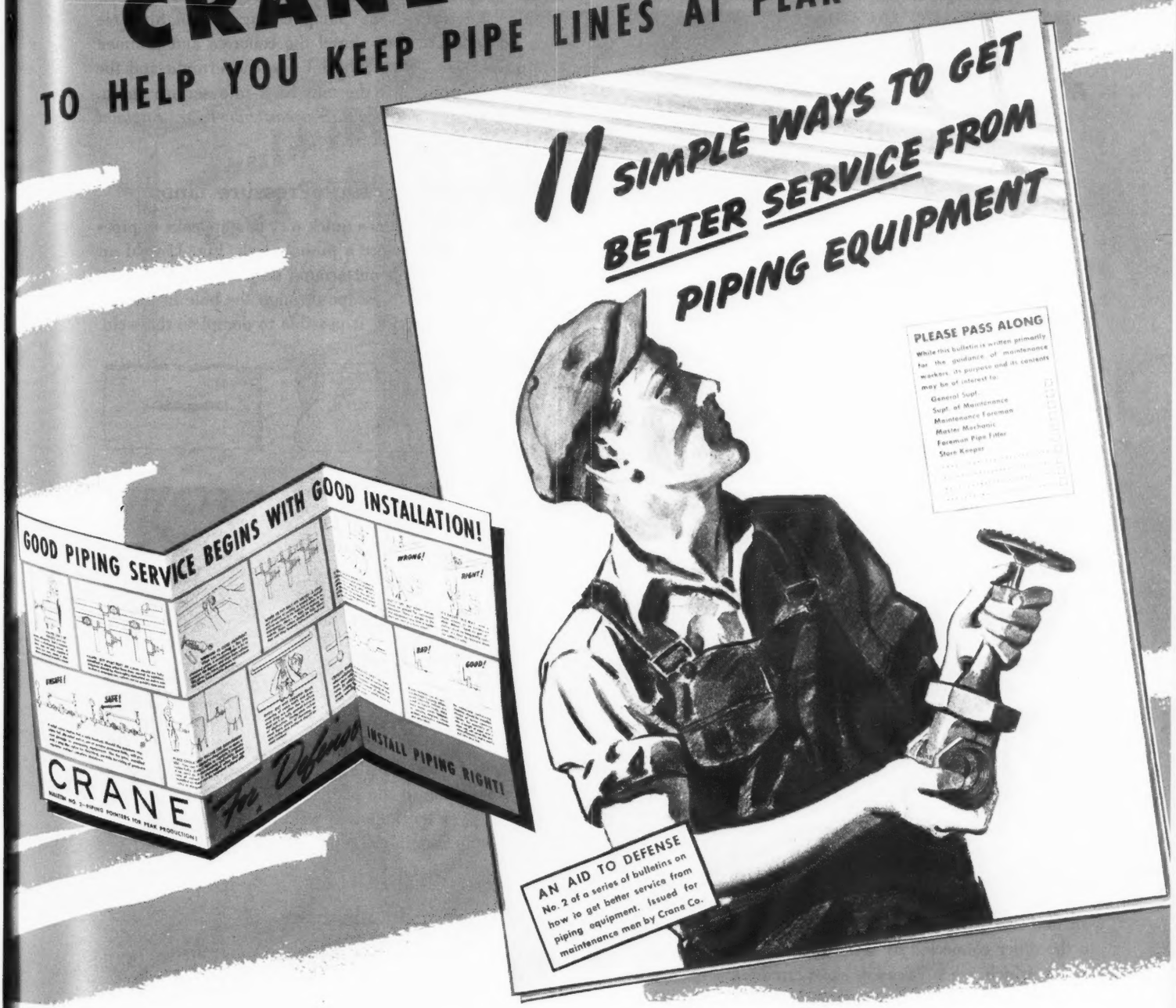


When a valve-stem rod on one of our reciprocating pumps snapped, a quick repair was made as shown in the diagram. For the coupling on the rod we screwed a coupling onto each end of a short ⅜-in. pipe nipple. With

(*Continued on page* 132)

A *New* CRANE SERVICE

TO HELP YOU KEEP PIPE LINES AT PEAK EFFICIENCY


11 SIMPLE WAYS TO GET BETTER SERVICE FROM PIPING EQUIPMENT
PLEASE PASS ALONG
While this bulletin is written primarily for the guidance of maintenance workers, its purpose and its contents may be of interest to:
General Supt.
Supt. of Maintenance
Maintenance Foreman
Master Mechanic
Foreman Pipe Fitter
Store Keeper
AN AID TO DEFENSE
No. 2 of a series of bulletins on how to get better service from piping equipment. Issued for maintenance men by Crane Co.
GOOD PIPING SERVICE BEGINS WITH GOOD INSTALLATION!
WRONG!
RIGHT!
BAD!
GOOD!
UNSAFE!
SAFE!
CRANE
For Defense
INSTALL PIPING RIGHT!

Look to this new service to help you in two timely ways: (1) In getting better service from your piping equipment; (2) In training and supervising maintenance crews. Bulletin No. 2 is now ready with many hints on proper piping applications and good installation practice. Copies distributed to your own maintenance men may prevent trouble at a time when trouble is mighty costly. Ask your Crane Representative—or write us—for full details about this new service and for copies of Bulletin No. 2. They're free—while the supply lasts.

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVENUE, CHICAGO

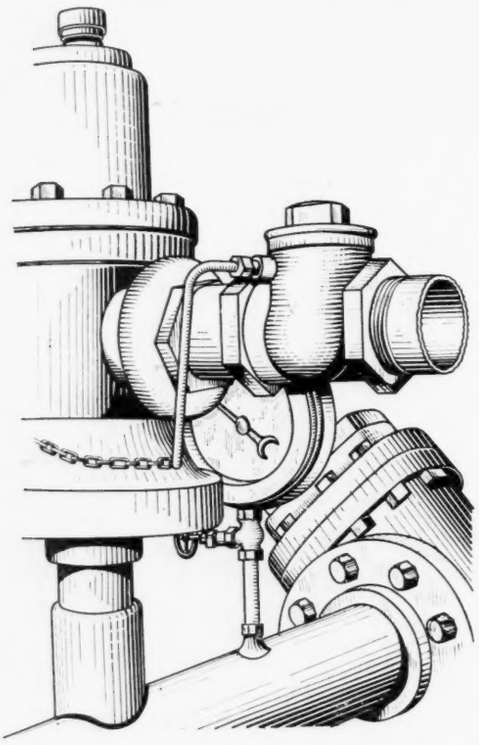
VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

a hacksaw we cut through the couplings and nipple, leaving ⅜-in. of coupling on each end of the nipple to serve as reinforcing rings.

Then we threaded the nipple on the inside, also the ends of the broken rod, and assembled them. Finally, we drilled through each end of the coupling and riveted in a ⅛-in. pin. ——*Alex Gray, Riverdale, N. Y.*

Automatic Pump-Pressure Regulator



The drawing shows a tested method of automatically stopping gasoline-engine-driven pumps. We welded a 2-in. coupling around a hole cut in the water line near the pump and connected pressure regulator *P*. Check valve *V* was installed in the discharge from the regulator. We removed the check-valve stem, welded a small packing gland around the hole in the valve body and made a combination pin and lever *L* from a piece of brass rod. On one end of the rod we mounted the valve disk and to the other connected by a light chain the trip pin of a switch, which, when released, short-circuited the magneto to stop the engine. ——*G M Wilson, Alhambra, Calif.*

Concrete Casing Keeps Pump Going

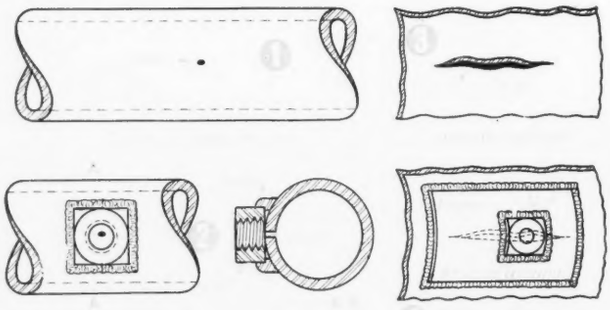
The cast-iron casing on one of our circulating-water pumps fractured. The crack, extending more than half way round the casing on the pressure side of the pump. also seriously weakened the flange supporting the outboard bearing for the impeller shaft.

First off, stiffening angles were welded between the flange and other sound parts of the casing. Contraction of these angles served to tighten the crack. To seal the crack and support the metal. and, in fact, take its place should it collapse, the entire pump was cast in concrete.

A form was erected, leaving necessary dismantling flanges open (the pump is dismantled axially), and reinforcing bars inserted. Concrete was mixed with small granite chippings, sharp sand, and quick-setting cement in the proportions 4:2:1 by volume, and made fairly sloppy. We washed the pump casing thoroughly free from oil and dirt, then pored the concrete and rammed it into the form. We let the job stand overnight and the following morning put the unit back into service again. ——*T D Oswald, Newcastle-on-Tyne, England*

Welding Repairs High-Pressure Lines

Electric arc welding is a quick way to stop leaks in pipes under pressure. To close a pinhole leak, Fig. 1, weld an ordinary machine bolt nut around the leak. This permits any water, air, etc., to escape through the hole in the nut during welding, making it possible to complete the weld.



The result is the simple yet effective patch shown in Fig. 2. To stop the leak screw a bolt into the nut with sealing compound.

A cracked or split pipe, Fig. 3, can be closed in the same way. This leak is usually too large to be covered by a nut, so a piece of plate stock is used for the patch. Drill a small hole in the plate, shape it to the pipe, then weld a nut over the hole and weld the plate to the pipe, Fig. 4. Then screw in the plug.

Dry Ice a Handy Shrinker

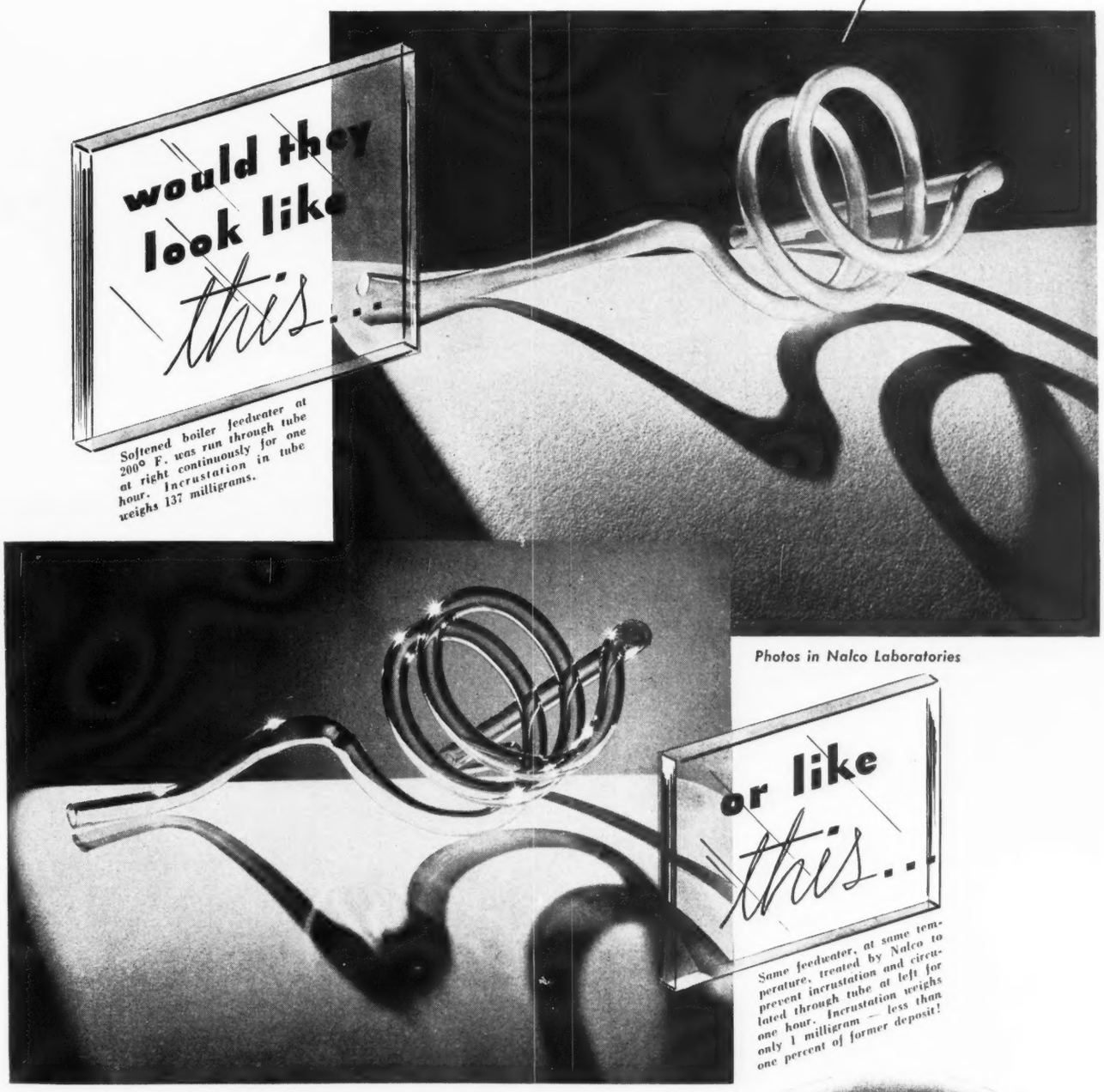
We were faced with the problem of removing the brass valve seats from a boiler-feed pump. An 8-ft handle on the wrench and plenty of man-power failed to start the seat. Then we placed dry ice on the valve seats for a few minutes—they shrunk enough so that one man could remove them with a 2-ft wrench. The same stunt can be used in other tight spots. *H P King, Rochester, N. Y.*

Piping Change Improves Valve Operation

Fig. 1 shows how the compressed-air system was connected in our plant. Air at 100 lb was stored in two receivers from where it was taken to the boiler for cleaning. 100-lb air was also taken through a reducing valve

(*Continued on page* 134)

IF YOUR FEEDWATER LINES WERE *Glass..*


would they look like this...
Softened boiler feedwater at 200° F. was run through tube at right continuously for one hour. Incrustation in tube weighs 137 milligrams.
or like this...
Same feedwater, at same temperature, treated by Nalco to prevent incrustation and circulated through tube at left for one hour. Incrustation weighs only 1 milligram — less than one percent of former deposit!

Photos in Nalco Laboratories

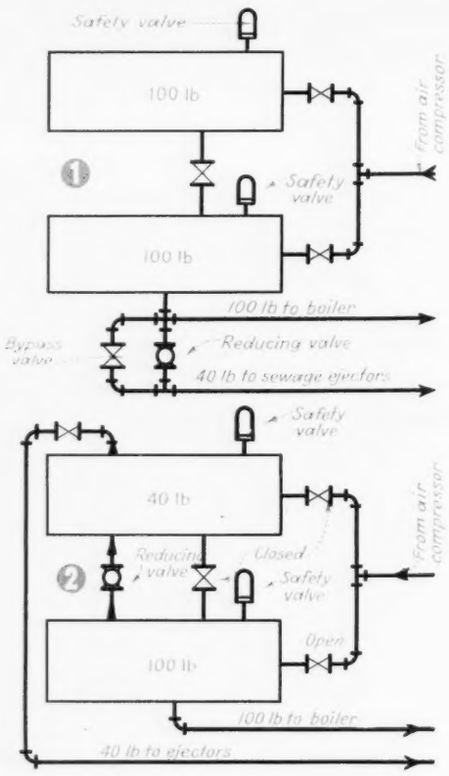
NALCO stabilized water that keeps feedwater lines clean is a small but important part of the integrated Nalco System. Research and experimentation in the Nalco Laboratories saves time and money in the field — Insures maximum economy and efficiency wherever the Nalco System is in use. Nalco Engineers will be glad to make recommendations for a complete solution of your water treatment problems. Write or call today.

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place • Chicago, Illinois

Canadian inquiries should be addressed to ALUMINATE CHEMICALS LTD., 555 Eastern Avenue, Toronto, Ontario

Nalco - the Complete Water Treating Service



and dropped to 40 lb for operating two sewage ejectors. We had trouble with noisy valves and pressure sometimes built up high enough to collapse floats in the ejectors.

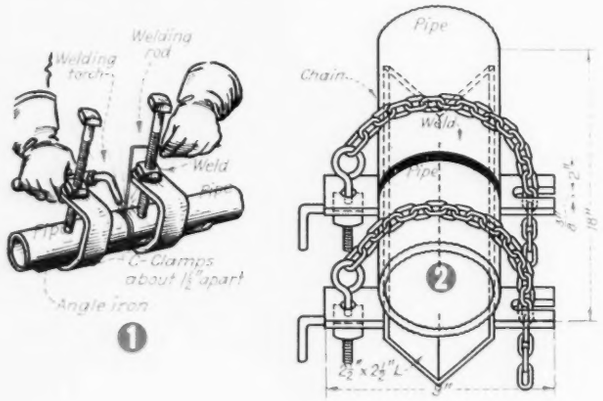
To eliminate these difficulties I changed the piping connections, see Fig. 2. This converted one of the 100-lb receivers for storage of 40-lb air. The valve now operates quietly and we have no more trouble with floats collapsing. ——*John Platt, New York, N. Y.*

Handy Clamp Aligns Pipe for Welding

Proper lining-up of pipe sections and holding them in place until tack welds are made can be done easily and quickly with the clamp shown in Fig. 1. This consists of two large home-made C-clamps welded, about 12 in. apart, to a section of angle iron. Nuts are welded over holes in the free ends of the C's for clamping bolts. After the pipe has been tack welded, the clamp may be removed and welding completed.

Fig. 2, another design of pipe-welding clamp used in shop work, consists primarily of two parallel steel plates connected by welding, 12 to 16 in. apart, to a section of angle iron. Two pieces of chain each connected to an eyebolt complete the clamp. A small piece of welding rod attached to each eyebolt nut forms a handle for quick operation of the clamp. Dimensions shown are for pipe sizes up to 3 in.; larger sizes can be handled by increasing clamp size.

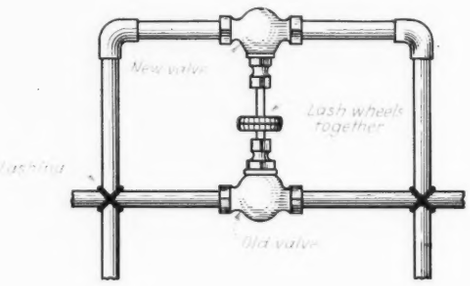
When adjusting the clamp, place a $\frac{1}{8}$- or $\frac{1}{16}$-in. welding rod across the two sides of the angle iron and butt the pipe against it. Tighten the clamp into place and the proper space is maintained between the pipe ends. Then remove the welding rods and make the tack-welds at three points around the pipe.——*T F Leach, New York, N. Y.*



Shutdown from Broken Valve Avoided

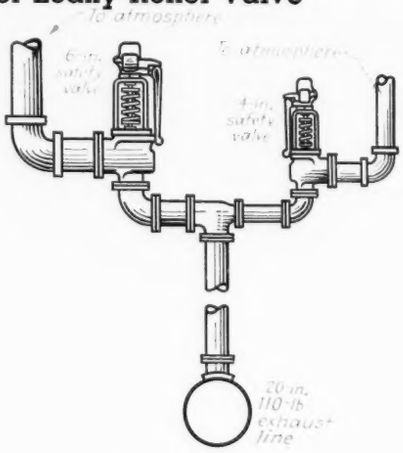
When threads failed on the stem of an old globe valve, we could not shut down the line to put in a new one. The day was saved with this temporary solution.

With four short pieces of pipe and two elbows, we connected the new valve so that it could be lashed to the old one and piping as shown. This permitted using the stem of the new valve to drive the old disk onto its seat. It worked until the line could be taken out of service.



——*H Moore, Leeds, England*

Cure for Leaky Relief Valve

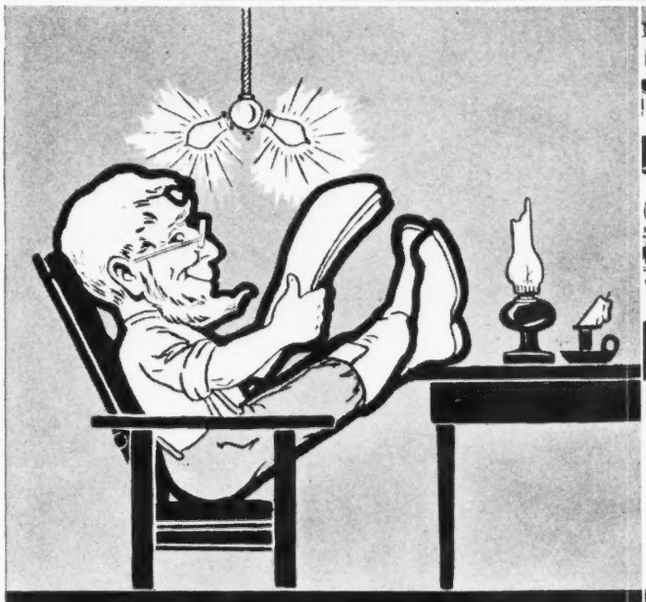


On our 20-in., 100-lb exhaust line from high-pressure turbine, we had a 16-in. relief valve that was difficult to

(*Continued on page* 136)

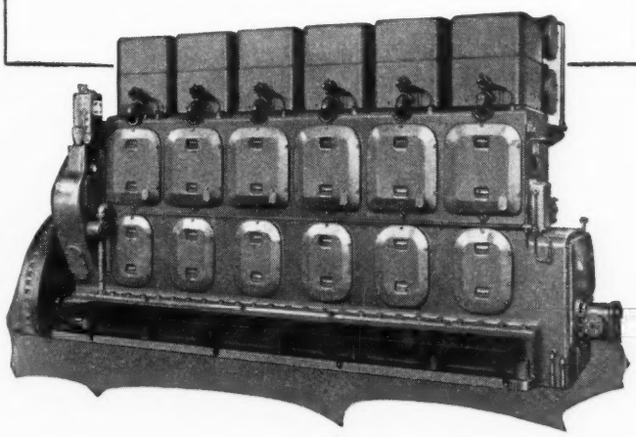
RIMES & RINKLES OF 1909

By De La Vergne



No more this farmer strains his eyes
Where lamps and candles burn.
His house as bright as bright can be,
Is lit by electricity.
Electric lights are cheap, you see,
When made by De La Vergne.

This Central Station Lighting Man
In grateful praise would join.
With De La Vergne Oil Engines he
Produces electricity
At small expense, and so you see
His pockets bulge with Coin.



Reproduced from an early De La Vergne advertising piece, these cartoons indicate the important part played by De La Vergne in the development and promotion of oil engines. De La Vergne diesel engines of today incorporate the cumulative result of forty-eight years of research and development.

Baldwin De La Vergne SALES CORP.

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2

keep tight. After trying various remedies to correct this trouble without success we replaced the valve with 4-in. and 6-in. safety valves, as in the figure.

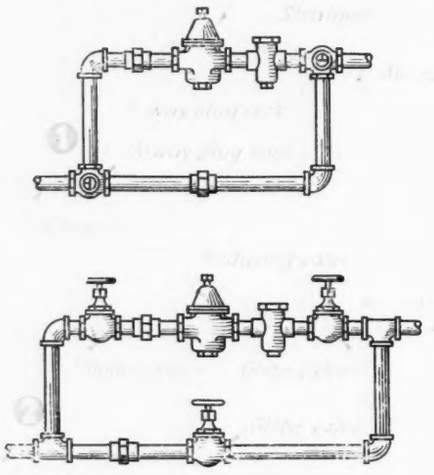
The 4-in. safety valve is set to blow at 125 lb and the 6-in. at 135-lb. Since installing these valves, they have not shown the least sign of leaking. The small valve seldom blows and the large one never, except when lifted off its seat by hand in testing.

——*John T Topolosky, Woodland, Maine*

Quick Pipe-Fitting Repair

A double-tee fitting broke in a large cast-iron pipe, because of poor pipe alignment and vibration. Since a new fitting was not readily available we made a distance piece to separate two of the flanges and close the crack. With two long threaded rods we pulled the crack tightly closed, then built a form around the double tee and poured in concrete. ——*S M Elonka, New York, N. Y.*

Plug Cocks Simplify Valve Hookup



The usual way of hooking up a reducing valve, shown in Fig. 2, requires three valves. A low-cost method, using two 3-way plug cocks (Fig. 1), simplifies bypassing the reducing valve; rotating the two cocks one-quarter turn will change the unit from reducing to bypass. Two valves must be closed and two opened to change from reducing to bypass or vice versa.——*R Boettinger, Englewood, N. J.*

Pumps Repaired with Metal Spray

When the wearing rings on a volute pump became badly worn, we put the rotor in a lathe and lightly grooved ring wearing surfaces with a sharp tool. Then we built up the rings by metal spraying, doing the job slowly to prevent over-heating the impeller and warping it. After spraying was completed, it was a simple matter to turn the ring in the lathe to a good fit.

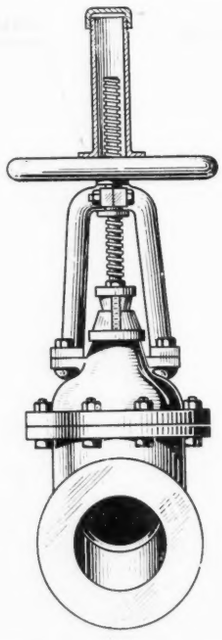
——*Orville Hoksch, Harvey, N. D.*

Roller Pipe Support Made by Welding

When installing some new equipment in a local plant, a pipe roller support was required by the pipe fitters. One of the welders built one, from material available around the plant. This proved to be so satisfactory that after the rush work was completed it replaced our older cast-iron roller support.——*A L Bennett, Hibbings, Minn.*

Cap Protects Valve Stem

With usual routine cleaning and lubrication, threaded stems of open rising-stem gate valves give little trouble if valves are indoors in a clean spot. Stem threads of outdoor valves should be protected against rain, dirt, dust,



knocks, ice accumulations and over-diligent painters. Same applies to indoor valves in exposed locations.

Sketch shows protective cap attached directly to hand wheel. Upper part is made of pipe section and cap. Lower flange may be welded or screwed on.

——*S H Coleman, Roanoke, Va.*

...and *Most* Economical in the Long Run!

THE worst enemy facing our national defense program is TIME. Rusted-out pipe wastes time in replacement... and it wastes money, too. Sometimes even the mere presence of rust can spoil work in process.

Fortunately many plants in our vital industries have copper tube for various types of fluid conveying lines. These are economical installations, moderate in first cost, low in maintenance.

That's why so many cost-minded maintenance men regard Anaconda Copper Tubes as the piping that's the most dependable and the least expensive in the long run... Anaconda Copper Tubes and Solder Type Fittings are sold through leading wholesale distributors everywhere.

ANACONDA
from mine to consumer

4117A

Anaconda Copper Tubes

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONN.

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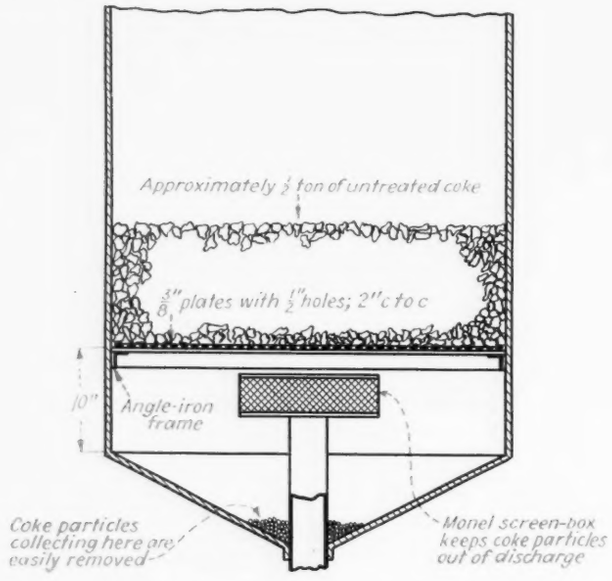
FEEDWATER

When you are crowding your boilers for the last ounce of steam, feedwater must be good or steam-generating units will go bad. These tested ideas will help keep them in good condition

Filter Removes Oil from Exhaust


Approximately ½ ton of untreated coke
⅜" plates with ½" holes; 2" c to c
10"
Angle-iron frame
Coke particles collecting here are easily removed
Monel screen-box keeps coke particles out of discharge

In our plant a baffle-type separator did a fair job of removing oil from engine exhaust going to a heating system, but inspectors always reported traces of oil in the boilers. Recent changes have cut oil in the feedwater from 10 to 3 ppm.

First, we added a tray of perforated metal plates about 10 in. above the bottom of the open feedheater. Plates were sized so they could be installed through the heater access door. The plates support a layer of untreated coke (about ½ ton), serving as a filter. Standpipe at the heater bottom extends into the space below the plates and carries a Monel screen box to prevent coke particles flowing out with the water.

Because filtering efficiency drops sharply when the coke accumulates oil, we replace the layer at 6-month intervals. Another filter, consisting of a cellulose-sponge layer above a layer of untreated coke, takes care of heating-system returns. ——*Frank Smart, New York, N. Y.*

Fixing Method Speeds Oxygen Test

With the Winkler method of determining dissolved-oxygen content of boiler-feed or other water, it is usually difficult to introduce fixing reagents without exposing sample to atmosphere. We have been able to simplify fixing and reduce the exposure with hypodermic needles.

Graduated 1.5-cc needles are equipped with replaceable points. With hydrofluoric acid, we burned a ⅛-in. hole in a regular bulb-type sample collector, Fig. 2. A piece of gum rubber about one inch square was then placed over the hole and secured by rubber bands.

We collect the sample in the usual way and add fixing

Fig. 1-Suitable Sampling Bottle

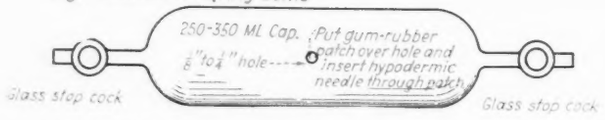

250-350 ML Cap.
⅛" to ¼" hole
Put gum-rubber patch over hole and insert hypodermic needle through patch
Glass stop cock
Glass stop cock

Fig. 2-Type of Sampling Bulb Used at Tucson

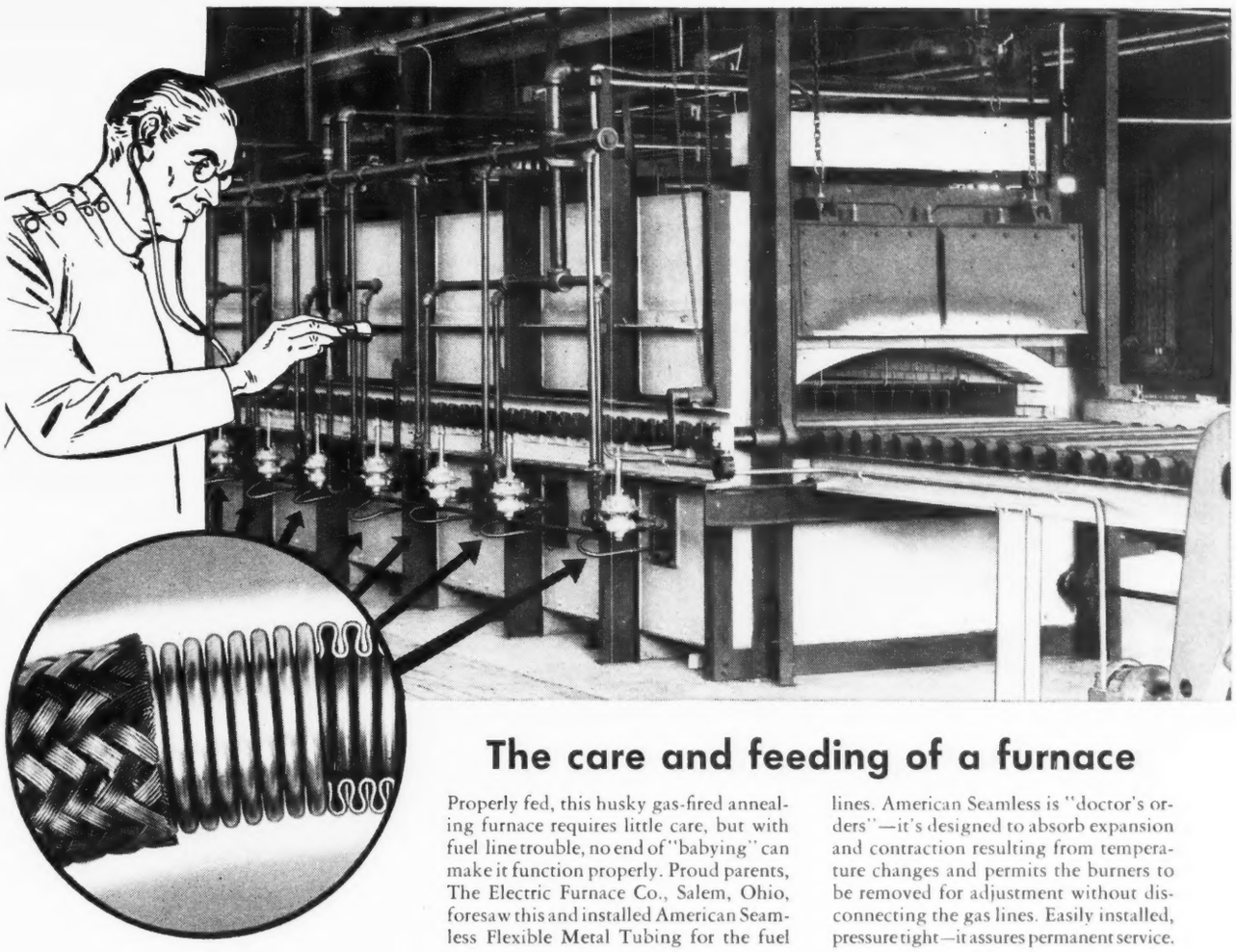
solutions by puncturing the rubber patch. Separate syringes and needles are used for each solution. Only possible contamination of the samples comes from small area of the needle itself. ——*Bill Maddock, Tucson, Ariz.*

Boiler Blow-Down Signal

In our plant are 18 stoker-fired boilers arranged three to a battery with two batteries facing each of three firing aisles. Each two batteries facing a firing aisle are operated as a unit. Blowoff connections from all boilers go into a common header discharging into the condenser circulating-water outlet canal. To avoid the objectionable effects of blowing down more than one boiler at a time we installed the signal system shown in the figure.

The signals consist of metal boxes, each containing a lamp behind a translucent front. Boxes are numbered

(*Continued on page* 140)



The care and feeding of a furnace

Properly fed, this husky gas-fired annealing furnace requires little care, but with fuel line trouble, no end of "babying" can make it function properly. Proud parents, The Electric Furnace Co., Salem, Ohio, foresaw this and installed American Seamless Flexible Metal Tubing for the fuel lines. American Seamless is "doctor's orders"—it's designed to absorb expansion and contraction resulting from temperature changes and permits the burners to be removed for adjustment without disconnecting the gas lines. Easily installed, pressure tight—it assures permanent service.

Consider these facts about *American Seamless* ...industry's super flexible tubing!

1. This flexible metal tubing, made from seamless tubes of various workable metals, *has no joints, welds, seams or packing of any kind.*

2. American Seamless in various types of installations both in the laboratory and in the field, has been flexed literally millions of times without sign of failure.

3. Reinforcing metal braids increase the ability of American Seamless to withstand high pressures under severe service conditions—for example, ½" I.D. with two braids, tests to a hydrostatic bursting pressure of 5,000 lbs. per sq. in.

4. Because of its all-metal construction, American Seamless is impervious to the chemical action of oils and the "drying up" effect of intense heat.

Details of the physical properties of American Seamless and other valuable engineering information is contained in our Bulletin No. 40. Illustrations show typical installations; diagrams accompany complete installation instructions. Write for your copy now. 4-1249

American Metal Hose

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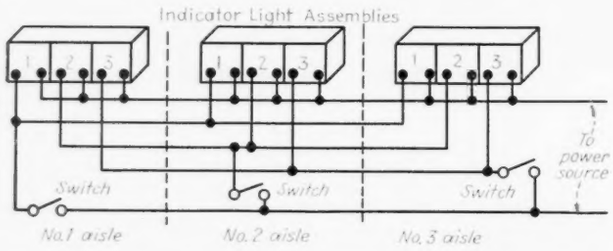
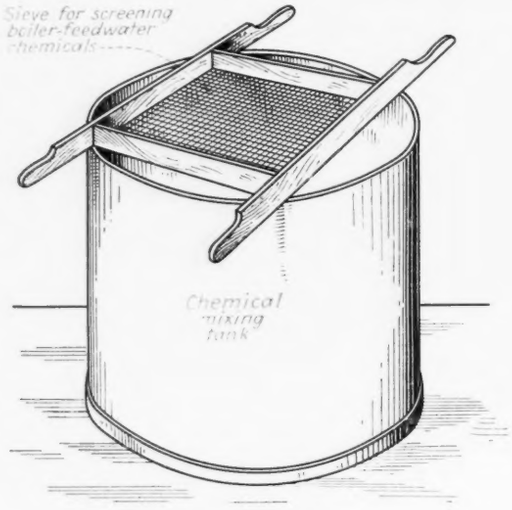


in groups of three, one lamp for each aisle. Lamps are grouped in each aisle where they can be seen easily. A switch in each aisle lights the lamp in each group corresponding to the aisle number.

Before blowing down a boiler, the operator glances at the indicator. If it shows clear he closes the switch in his aisle, say No. 2, and a lamp in each group lights to show the other operators that a boiler on No. 2 aisle is being blown down. After blowing down, the switch is opened to signal all clear. ——*S H Coleman, Roanoke, Va.*

Screen Feedwater Chemicals

When mixing dry chemicals into boiler feedwater-treating solutions, keep large chunks out of the mixing tank. These dissolve very slowly, waste time, and require a lot of straining and possible crushing. Often they do not dissolve completely and result in an uneven solution which may upset boiler-water conditions.

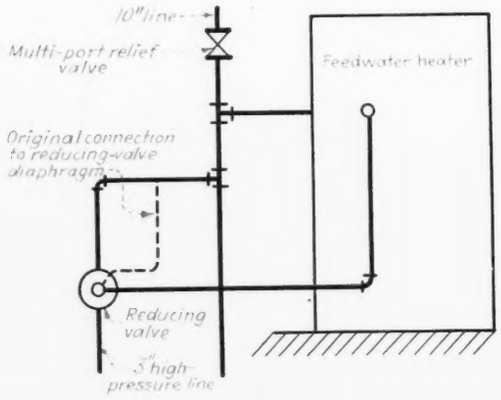


You can avoid all these troubles by screening; where necessary, break lumps to go through screen. Mesh should be strong enough to stand rubbing. If chemicals are harmful to the hands, wear protective gloves.

Piping Change Holds Feed Temperature

We found it difficult to keep feedwater temperature at 215 F in our feed heater when load was heavy. Heating was done with some exhaust steam supplemented by live steam controlled through a valve that reduced boiler pressure to 3 lb.

The 3-in reducing valve is connected by about 6 ft of 3-in. pipe into a 10-in. line going into the heater. Originally, the reducing-valve diaphragm connected to the 3-in. line about 4 ft from the valve on the low-pressure side. Pressure on the 3-in. line held up, but during heavy loads expansion into the 10-in. line and then into the heater caused the pressure to drop to zero.

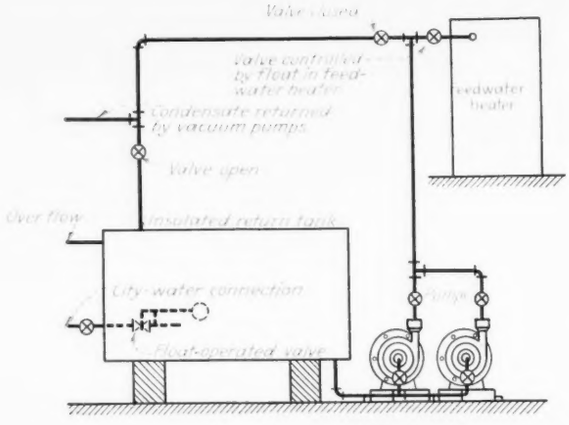


Connecting a line from diaphragm to steam compartment of the heater, see diagram, solved the problem. ——*H P King, Rochester, N. Y.*

Makeup Water Reduced 50%

Heating-system condensate used to be returned intermittently by motor-driven vacuum pumps directly to our feedwater heater. The heater was not large enough to hold the flow for any one operation of the vacuum pumps and overflow went to the sewer. Before the pumps operated again makeup from the city main had to be supplied to the heater. This caused a large loss of condensate and required about 40% makeup.

To correct this condition we put a well-insulated return tank in the basement and connected the return-water line to it. A float-controlled makeup connection comes into this tank from the city main, so all makeup water mixes with the condensate before going to the heater. Duplicate centrifugal pumps discharge water from return tank to heater through a float-controlled valve. Now the heater no longer overflows and the makeup has decreased to 20%, a decided saving in both makeup water and in steam for heating the water. ——*H P King, Rochester, N. Y.*



KEARSARGE BOILER GASKETS are virtually standard equipment for sealing manholes, handholes and tube plates.

They're tougher and they stand up longer. Made of a strong, durable asbesto-metallic cloth treated with a special heat-resistant compound, they give a tight seal every time—eliminate shutdowns for replacement. Their long, economical service is typical of the complete line of J-M Packings and Gaskets.

• • •

For full details, write for the new J-M Packing Catalog, PK-12A. Johns-Manville, 22 East 40th Street, New York, N. Y.

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Johns-Manville PACKINGS & GASKETS

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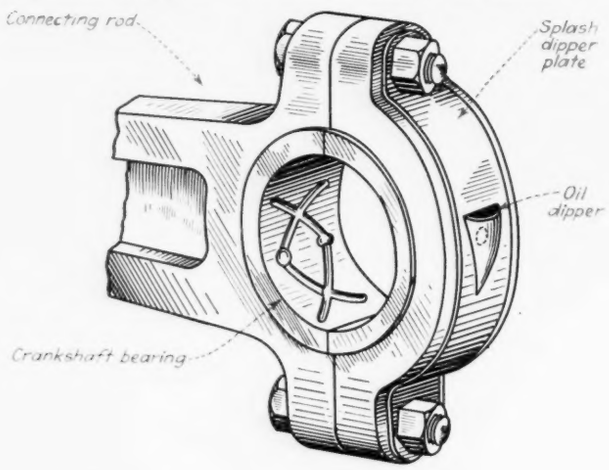
LUBRICATING EQUIPMENT

When something goes wrong with the lubrication system, bearings get hot and machine shutdown may follow quickly. These hints from the firing line of experience may mean the difference between being on schedule and being a production bottleneck

Splash-Dipper Cures Bearing Trouble



On our pumping engines we had difficulty in properly lubricating crankshaft connecting-rod bearings. These bearings were splash-lubricated but they apparently did not get sufficient oil.

We solved the problem by putting an oil dipper and pocket on each bearing, see drawing. This consists of a forged-steel U with a triangular hole in its center. Around the hole we welded a semi-circular pocket to dip and hold the oil at a hole into the bearing oil grooves. The dipper is held tightly in place around the bearing cap by the cap bolts. ——*C H Willey, Penacook, N. H.*

Troublesome Oil Leak Stopped

In one plant an oil leak was traced to the filler cap on the oil reservoir. Several thicknesses of gauze used to strain the oil were left in the hole and the cap jammed down tightly onto it.

Eventually, the gauze became filled with dirt and residue from the oil and sealed the only outlet for ventilating and lubricating system. A pressure then built up in the system that caused oil leakage through the clearances. This trouble was corrected by simply removing the gauze strainer, so that vapors could vent through ribs in the filler cap. ——*T C Cheatham, Fort Pierce, Fla.*

Millivoltmeter Checks Oil Quality

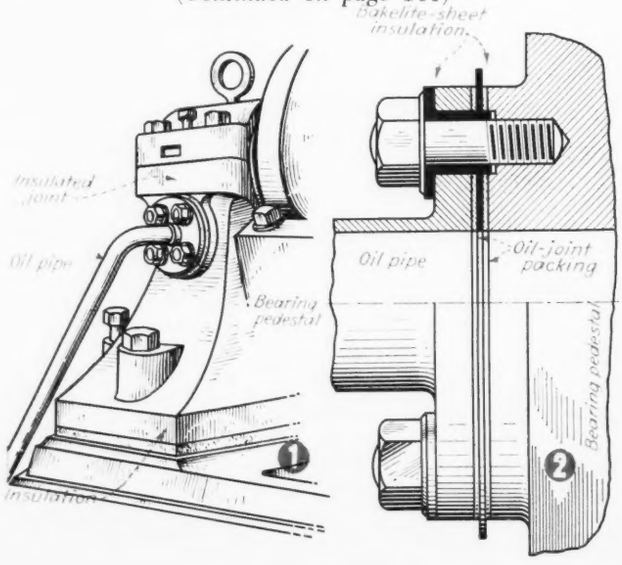
One of our turbine bearings overheated. Thinking the trouble might be caused by shaft currents we insulated the bearing pedestal, but this didn't help much.

We then took a sample of the oil at operating temperature, and put into it two electrodes, one of steel and the other of babbitt metal. A millivoltmeter connected to the electrodes showed a reading of $\frac{1}{2}$ millivolt, indicating an acid condition. We changed the oil to one that would not give a reading on the millivoltmeter and have since had no more trouble. ——*H W Hodgson, Plainfield, N. J.*

Insulated Oil-Pipe Joint Stops Sludging

Lubricating oil sludged due to bearing currents on one of our turbine-alternators which had a supposedly insulated bearing pedestal. A $\frac{1}{8}$-in. Bakelite sheet under the pedestal, and bushings of the same material on the bolts, insulated the pedestal, but the oil-pipe-flange connection to the bearing, Fig. 1, had been overlooked. We tried a variety of materials in the joint, but failed to find one that gave a satisfactory oil-tight insulated joint.

(*Continued on page* 144)



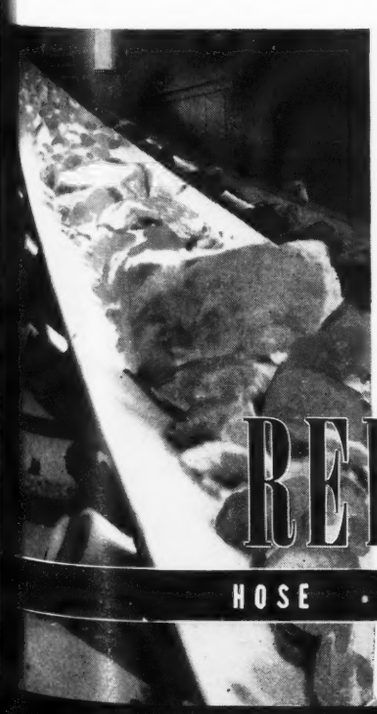
REPUBLIC'S *New Shock-Absorber* CONVEYOR BELT

Puts the Disappearing Act on Impact

Impact... destructive enemy of conveyor belts handling heavy lump material in mines, quarries, construction projects, etc. . . . has long been showing up in the form of punctures in the rubber belt covers and subsequent rupture of the fabric plies. The constant shock and pounding of falling rock, ore and coal at the loading point was often too much for the conventional belt construction to stand. Trouble was, the force of impact was confined to a closely localized area . . . would strike the fairly stiff wear surface and be immediately transmitted through the underlying breaker to the hard belt body.

Republic's newly patented* development, Republic Shock-Absorber Conveyor Belt, overcomes this damaging effect of impact by literally making it disappear out of harm's way. A specially compounded layer of soft, resilient, cushioning rubber is interposed between the cover and the fabric body of the belt. This "cushion" has the necessary properties to spread and dissipate the force of rock and ore striking the belt. The resulting elimination of damage has proved capable of almost unbelievable increases in belt service life. REPUBLIC RUBBER DIVISION OF LEE RUBBER AND TIRE CORPORATION, YOUNGSTOWN, OHIO.

* U. S. Patent No. 2,237,173



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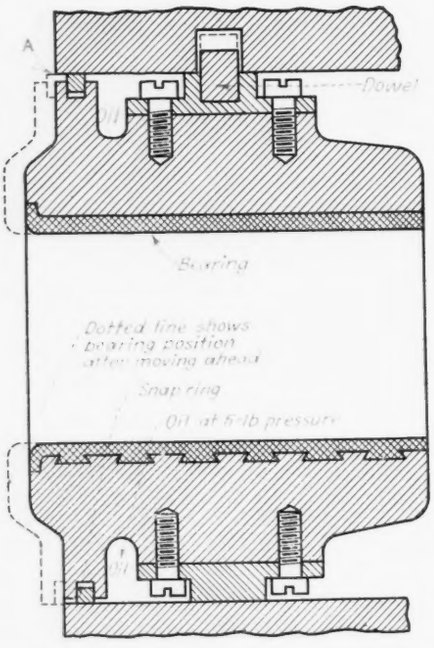
We eventually licked the problem by making the joint as in Fig. 2. A $\frac{1}{32}$-in. thick ring of Bakelite composition, larger in diameter than the oil-pipe flange, provides the electrical insulation. Oil tightness is obtained by a $\frac{1}{32}$-in. oil-joint packing, the same diameter as the pipe flange, on each side of the insulation. Studs were insulated with bushings turned from solid Bakelite composition and the joint was made up with oil-resisting varnish.

——*J D Oswald, Newcastle-on-Tyne, England*

Turbine-Bearing Oil Leak Stopped



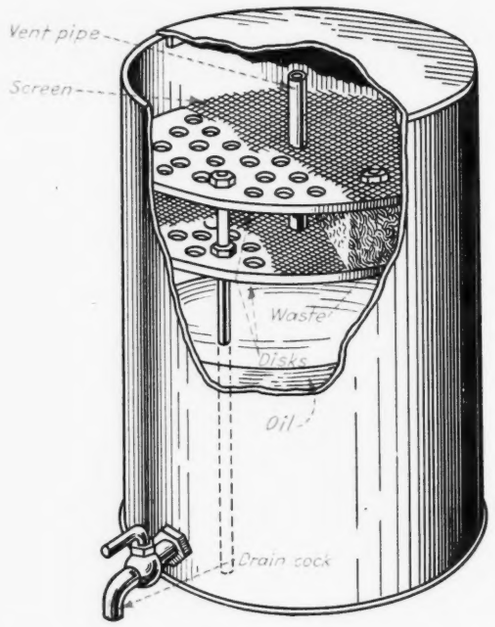
When an unusual oil leak occurred on the thrust-end main bearing of our 1500-kw steam turbine, oil-reservoir level fell to the low mark, a loss of 4 gal of oil, in 4 hours.

The bearing is held in a housing filled with oil under 5-lb pressure; leakage from the housing is prevented by a snap ring, shown in the drawing. We found that the dowel holding the bearing in its housing had worked loose and allowed it to move ahead as indicated by the dotted lines. In this position, the snap ring extended far enough beyond the housing to allow oil to leak out. To prevent the dowel pin from working loose again we welded it in place. ——*T C Cheatham, Fort Pierce, Fla.*

Easy-to-Make Oil Cleaner

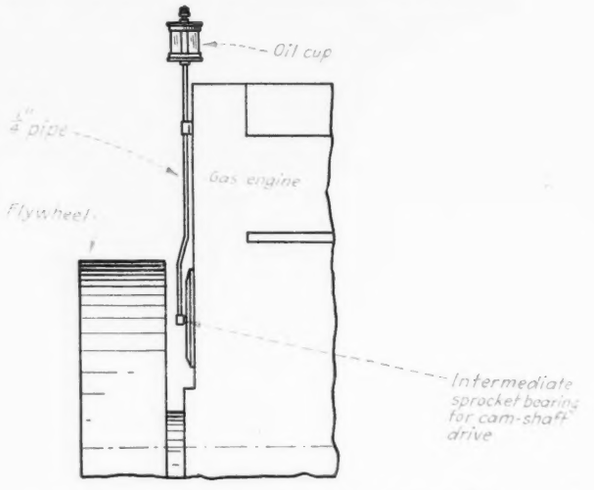
A thick coating of sludge settled to the bottom of our dirty-oil tank, which meant we had to take the tank out of service and clean it. Apparently most of this material came from drip pans and drain lines, so we decided to filter partially this oil before it went to the dirty-oil tank. To do this job we made a filter from a 5-gal red-lead can.

Part way down in the can we supported a filtering element made from two sheet-metal disks fitted snugly into the can. We drilled a large number of 1-in. holes in these disks and soldered a fine-mesh screen wire to their top surface. They were then assembled on three vertical rods as shown to support them in the can. A short length of pipe passing through the two disks vented the bottom compartment of the filter. A drain valve connected in near the bottom of the can completed the job.



Space between the two disks was filled with waste. When the waste clogs the filtering element is easily removed and cleaned. ——*S M Elonka, New York, N. Y.*

Oil Cup Solves Lubrication Problem

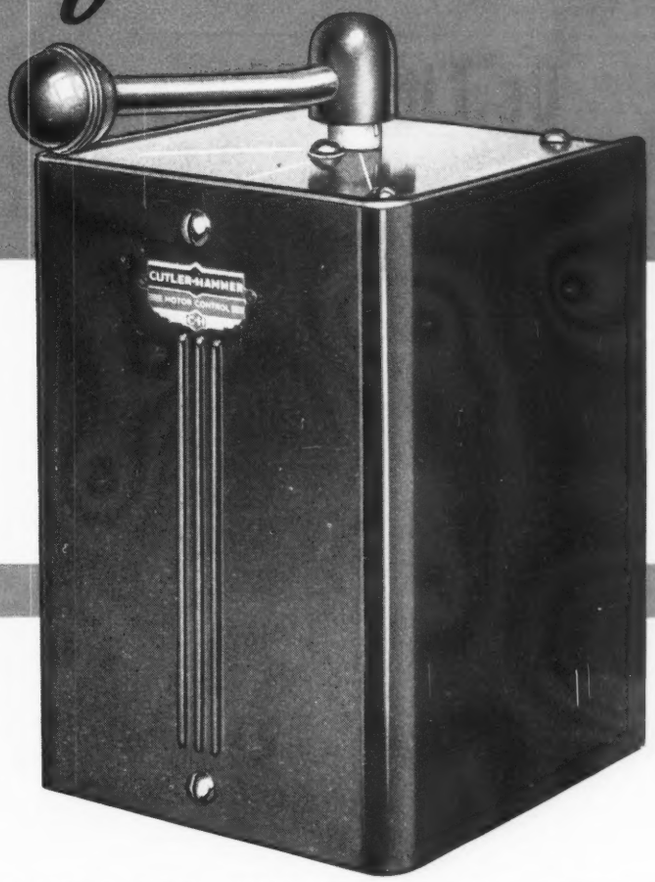


A ball bearing burned out on the intermediate sprocket for a chain-driven camshaft on one of our 300-hp gas engines. This bearing is normally splashoiled, but oil engines. This bearing is normally splash-oiled, but oil was not sufficient.

By drilling and tapping a hole through the bearing cover and extending a ¼-in. pipe up from this hole above the engine rocker arms, we solved the problem. On the upper end of the pipe we put a glass-body cup oiler. This oiler is filled each time we oil the camshaft and fill the rocker cups. ——*James F Maher, Shiprock, N. M.*

An Important ANNOUNCEMENT For Every User of A.C. Motors

CUTLER-HAMMER ANNOUNCES *the new Size 1 C-H Reversing Drum Controller*



WHEREVER demonstrated, this new Drum Controller has been received with only the highest praise; and more than once engineers have been heard to say: "It beats anything I've ever seen!"

It's an enlarged version of the C-H Size O Drum which has been so successful; but more than that, it incorporates many entirely *new* features of design which place it way ahead of the field.

The mouldings are made from C-H Thermoplax which withstands much more severe arcing than the former type of mouldings. Easily removable arc barriers completely isolate the 3 phase contacts. Sturdy bearings in each end of drum and the "twin-break" principle mean long life even under the worst possible conditions. Its "Ball-lever" operation makes it easy and convenient to operate even when the operator is wearing heavy gloves or his hands are slippery with oil.

The new C-H Drum Controller is available for A.C. motors from 1½ to 7½ hp., and is also available as a two speed non-reversing controller (Bulletin 9402) for either two-winding or single-winding A.C. motors.

And you need pay no premium for these outstanding new features or for Cutler-Hammer's world-famous dependability. The Drum Controller sells for only $12.00 . . . a quality product at low cost. Write at once for full informc-tion. CUTLER-HAMMER, Inc., 1358 St. Paul Ave., Milwaukee, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto.

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New Bulletin 9441, NEMA Size 1, Reversing Drum Controller

1. New Thermoplax mouldings withstand very severe arcing on reversing or plugging service.

2. Removable arc barriers below stationary contact board — completely isolate the three phase contacts.

3. "Ball-lever" operation. Easy to operate with gloves or oily hands.

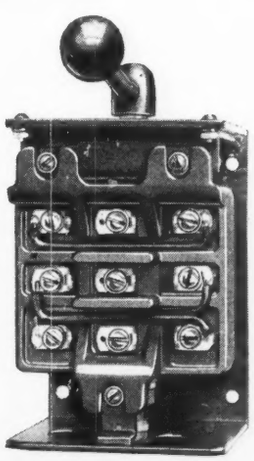
4. "Twin Break" contacts. They halve the arc voltage—reduce arc and greatly increase life of contact.

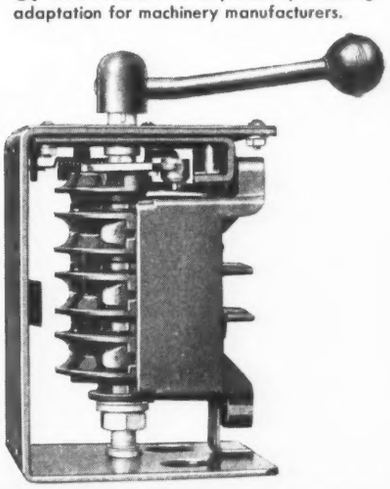
5. Non-stubbing contacts with wiping action and spring follow-up assure clean contacts at all times.

6. Heavy duty bearings in each end of drum enable controller to stand up under the toughest operating conditions.

7. Pistol grip handle optional.

8. Also available in unique cavity mounting adaptation for machinery manufacturers.





ADVERTISING PAGE REMOVED

Us Little Men . . .

ONCE, LONG AGO, there grew on the shores of the Nile a great nation. Its Pharaohs, its commerce, its culture were the envy of the rest of the world. Its great men and its learned men are remembered even twenty centuries and thirty centuries later. Its little men are forgotten. The little men—like us.

But who built its Sphinx, its pyramids, who tended its crops and fought its wars? Who built its cities and supplied the virile stock from which its great men were drawn? Its little men—like us.

Our world is entering its third year of war. Our big men all see God on their side, all speak of fighting to the end, of dying for what they know is right. But who must do that fighting to the end, that dying? The little men—like us.

A great man has recently said, "Never in the history of the world have so many owed so much to so few." I say, as the little man says, "Never in the history of the world have so few owed so much to so many." There must, of course, be great men to follow. But is it the great men who keep China alive? Is it the general who, when guns are gone, fights with his fists, when his home is destroyed lives in the open, when his tools are destroyed works on uncomplainingly with his bare hands? Was it the generals who lost the First World War for Germany? Is it the great men of England and Russia that keep their countries fighting on against almost insuperable odds? You guessed it—it's the little men. It could be us.

Why, damn it, it *is* us! Let them talk as they will of mighty armies and navies, of a country's resources and its manpower. What are those resources, that manpower, those armies, navies? You're right again—it's **us!**

Don't let anyone tell you that the part you can play, or I can play, or anyone else can play, is not important. The coal you save, the gasoline I save, and the aluminum our wives save, lumps together into a saving that no great man could ever hope to make. It's those savings, those economies, those millions of repeated self-denials that will win this war, that have won all other wars. When all is said and written, let the credit go where it will, our civilization will be saved as it was built, by the little men—by **us!**

George Edwards

Engineer

. . . TO GOOD VALVE *PRACTICE* . . .

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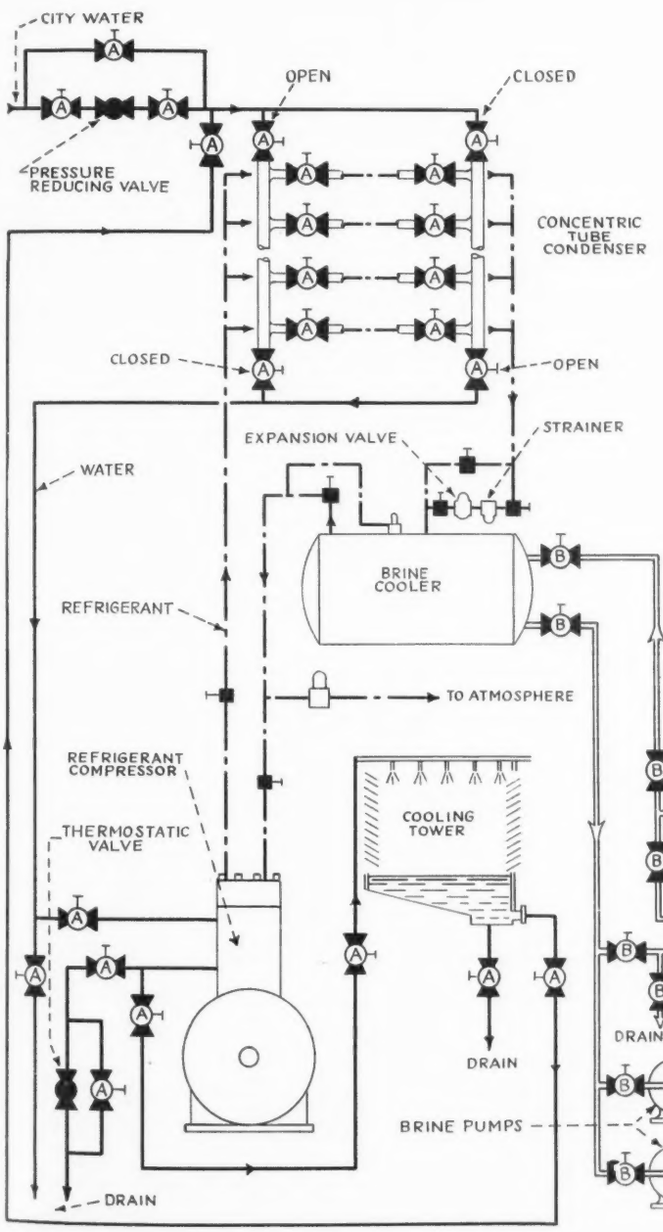
BRINE CONNECTIONS



REFERENCE CHART FOR JENKINS FIGURE NUMBERS

		Standard	Medium	Extra Heavy
A	WATER LINES GATE	BRONZE 47 Sc. Travel Spindle 49 Sc. Travel Spindle 370 Sc. Non-Rising IRON 325 Sc. Non-Rising 326 Fl. Non-Rising	BRONZE 270 Sc. Non-Rising IRON 251 Sc. Non-Rising 255 Fl. Non-Rising	BRONZE 240 Sc. Non-Rising IRON 203A Sc. Non-Rising 203 Fl. Non-Rising
	SWING CHECK	BRONZE 92 Sc. Regrinding 352 Sc. Disc Type 762 Sc. Regrinding IRON 623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type	BRONZE 762 Sc. Regrinding IRON 338 Sc. Disc Type 339 Fl. Disc Type	BRONZE 260 Sc. Disc Type 962 Sc. Regrinding IRON 338 Sc. Disc Type 339 Fl. Disc Type
	GLOBE	BRONZE 106A Sc. Disc Type IRON 612 Sc. Regrinding 613 Fl. Regrinding 141 Sc. Disc Type 142 Fl. Disc Type	BRONZE 750 Sc. Regrinding 950 Sc. Regr. Renew IRON 918 Sc. Regrinding 919 Fl. Regrinding 774 Sc. Disc Type 775 Fl. Disc Type	BRONZE 901 Sc. Disc Type 1140 Sc. Regrinding 1150 Sc. Regr. Renew 970 Sc. Regr. Renew IRON 922 Sc. Regrinding 923 Fl. Regrinding 162A Sc. Disc Type 162 Fl. Disc Type
B	BRINE LINES GATE	IRON* 650 Sc. O.S. & Y. 651 Fl. O.S. & Y. 325 Sc. Non-Rising 326 Fl. Non-Rising 42A Sc. U-Bolt 43A Fl. U-Bolt ALL-IRON 95 Sc. Non-Rising 97 Sc. Non-Rising 98 Fl. Non-Rising 99 Sc. O.S. & Y. 100 Fl. O.S. & Y. 40A Sc. U-Bolt 41A Fl. U-Bolt	IRON* 277 Sc. O.S. & Y. 253 Fl. O.S. & Y. 251 Sc. Non-Rising 255 Fl. Non-Rising	IRON* 204A Sc. O.S. & Y. 204 Fl. O.S. & Y. 203A Sc. Non-Rising 203 Fl. Non-Rising
	SWING CHECK	IRON* 623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type	IRON* 338 Sc. Disc Type 339 Fl. Disc Type	IRON* 338 Sc. Disc Type 339 Fl. Disc Type
	GLOBE	IRON* 612 Sc. Regrinding 613 Fl. Regrinding 141 Sc. Disc Type 142 Fl. Disc Type ALL-IRON 75DA Sc. Disc Type 75A Sc. Regrinding	IRON* 918 Sc. Regrinding 919 Fl. Regrinding 774 Sc. Disc Type 775 Fl. Disc Type	IRON* 922 Sc. Regrinding 923 Fl. Regrinding 162A Sc. Disc Type 162 Fl. Disc Type
C	STEAM LINES GLOBE	BRONZE 106A Sc. Disc Type 750 Sc. Regrinding 950 Sc. Regr. Renew 956 Sc. Regr. Renew Plug	BRONZE 901 Sc. Disc Type 1140 Sc. Regrinding 1150 Sc. Regr. Renew	BRONZE 970 Sc. Regr. Renew 976 Sc. Regr. Renew Plug
	GATE	BRONZE 47 Sc. Travel Stem 49 Sc. Travel Stem 370 Sc. Non-Rising	BRONZE 270 Sc. Non-Rising	BRONZE 240 Sc. Non-Rising
	SWING CHECK	BRONZE 92 Sc. Regrinding 352 Sc. Disc Type	BRONZE 762 Sc. Regrinding	BRONZE 260 Sc. Disc Type 962 Sc. Regrinding

*Iron Body-Bronze Mounted Valves are also made in All-Iron Construction

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U. S. Bureau of Reclamation Proposed Program of New Steam and Hydro Installations

(For equipment now being installed, see page 104; for Federal Power Commission's Proposed Hydro Program, see page 107)

Project	Stream	Plant	State	[1] Kilowatts to be Installed 1943	1944	1945	1946	1947	Total	Firm Capacity
WASHINGTON, NORTHEAST OREGON AND NORTHERN IDAHO.										
Cabinet Gorge	Clark		Idaho	99,000					99,000	50,000
Columbian Basin	Columbia	Grand Coulee	Wash		432,000				432,000	284,000
[1] Klickitat	Klickitat	2 Plants	Wash		70,000				70,000	20,000
[2] Snoqualmie	Snoqualmie	2 Plants	Wash		56,000				56,000	25,000
Sultan River	Sultan		Wash		60,000				60,000	27,000
[2] Stayton	North Santiam	Detroit	Ore.		50,000				50,000	25,000
Priest Rapids	Columbia		Wash			650,000			650,000	350,000
[2] Stilaquamish	Deer Creek	4 Plants	Wash			112,000			112,000	42,000
Columbia Basin	Columbia	Grand Coulee	Wash			540,000			540,000	183,000
Columbia Basin	Columbia	Grand Coulee	Wash				324,000		324,000	10,000
Umatilla Rapids	Columbia		Wash.—Ore.				850,000		850,000	180,000
The Dalles	Columbia	Celilo Falls	Wash.—Ore.				420,000		420,000	225,000
Z Canyon	Clark Fork	Z Canyon	Wash				200,000		200,000	100,000
SOUTHERN OREGON AND NORTHERN CALIFORNIA										
Roque River	Defense Gap	Roque River	Ore.		30,000				30,000	15,000
Scott Valley	Scott	Scott	Calif.		50,000				50,000	25,000
NORTHERN CALIFORNIA AND WESTERN NEVADA										
Steam Plant	Antioch		Calif.	150,000					150,000	150,000
American River	American	3 Plants	Calif.		130,000				130,000	55,000
Kings River	Kings	3 Plants	Calif.		146,000				146,000	50,000
Truckee Storage	Truckee		Nev.		18,000				18,000	9,000
Steam Plant	Newark		Calif.		75,000				75,000	75,000
Steam Plant	Sacramento		Calif.		75,000				75,000	75,000
[4] Feather River	Feather	Oroville	Calif.					225,000	225,000	90,000
SOUTHERN CALIFORNIA, NEVADA AND ARIZONA										
All American Canal	All-American Canal	Pilot Knob	Calif.	33,000					33,000	15,000
Boulder Canyon	Colorado	Boulder	Ariz.&Nev.		165,000				165,000	100,000
Boulder Canyon	Colorado	Boulder	Ariz.&Nev.			205,000			205,000	
Bridge Canyon	Colorado	Bridge Canyon	Ariz.				400,000		400,000	200,000
UTAH AND IDAHO										
Steam Plant			Utah	100,000					100,000	100,000
Anderson Ranch	Snake	Anderson Ranch	Idaho		20,000				20,000	10,000
Mountain Home	Scriver Creek		Idaho		60,000				60,000	30,000
Snake River Storage	Snake	Palisades	Idaho			30,000			30,000	14,000
Colorado-Green River	Green	Split Mountain	Utah			75,000			75,000	45,000
Colorado-Green River	Green	Echo Park	Utah				125,000		125,000	75,000
Dewey	Colorado		Utah				290,000		290,000	130,000
Rattlesnake	Green		Utah					70,000	70,000	[5] 40,000
Dark Canyon	Colorado		Utah					600,000	600,000	300,000
COLORADO, WYOMING AND NORTHEAST NEBRASKA										
[6] Steam Plant	Colorado-Big Thompson	Fort Collins	Colo.	110,000					110,000	110,000
Montrose	Uncompahgre	3 Plants	Colo.	17,000					17,000	8,000
Kendrick	North Platte	Kortes	Wyo.		30,000				30,000	12,000
North Platte	North Platte	2 Plants,	Wyo.			26,000			26,000	12,000
[7] Blue South Platte	So. Platte	3 Plants,	Colo.			90,000			90,000	25,000
Gunnison-Arkansas	Gunnison	Iola Reservoir	Colo.				60,000		60,000	30,000
MONTANA										
Canyon Ferry	Missouri	Canyon Ferry	Mont.		50,000				50,000	30,000
Big Horn	Big Horn	Lower Big Horn	Mont.			100,000			100,000	45,000
[8] Hungry Horse	Flathead		Mont.				172,000		172,000	80,000
SOUTH DAKOTA										
[9] Fort Randall	Missouri	Garvin's Point	S.Dak.			123,000			123,000	30,000
Mobridge Big Bend	Missouri		S.Dak.				200,000		200,000	75,000
[10] **ARKANSAS, OKLAHOMA, KANSAS AND MISSOURI**										
Nimrod	Arkansas		Ark.	14,000					14,000	2,000
Steam Plant		Bauxite	Ark.	150,000					150,000	150,000
Norfolk	White		Ark.		140,000				140,000	20,000
Greer's Ferry	White		Ark.		78,000				78,000	11,000
Water Valley	White		Ark.		24,000				24,000	6,000
Steam Plant	White	Aluminum	Ark.		150,000				150,000	150,000
Fort Gibson	Grand	Fort Gibson	Okla.		40,000				40,000	12,000
Ten Killer Ferry	Illinois		Okla.		30,000				30,000	5,000
Markham's Ferry	Grand	Markham'sFerry	Okla.			40,000			40,000	12,000
Bull Shoals	White		Ark.			190,000			190,000	32,000
Table Rock	White		Mo.			140,000			140,000	22,000
Topeka	Kansas	Topeka	Kan.				60,000		60,000	27,000
TEXAS AND NEW MEXICO										
Guadalupe	Guadalupe		Texas		16,000				16,000	6,000
[11] Marble Falls	Colorado, in Texas		Texas		30,000				30,000	5,000
Neches	Neches and Angeling	4 Plants	Texas			45,000			45,000	15,000
[12] Brazos	Brazos	5 Plants	Texas			59,000			59,000	30,000
San Juan Chama	Trans Mt Div	7 Plants	N. M.			70,000			70,000	30,000
Valley Gravity Storage, Lower Rio Grande	Los Olmos and Rincon	Los Olmos	Texas				18,000		18,000	11,000
Total				538,000	2,025,000	2,495,000	3,119,000	895,000	9,072,000	4,142,000

[1] Completion possible in year indicated.
[2] Investigated by Corps of Engineers, War Department.
[3] Investigated by the Office of Indian Affairs.
[4] Reported in California State Bulletin, No. 26.
[5] After upstream storage is provided.
[6] Does not include Big Thompson hydro plants under construction with 181,000 kw installed capacity.
[7] Firm power dependent on completion of entire Blue South Platte project.
[8] Being installed by U. S. Corps of Engineers.
[9] Reported by Federal Power Commission Market Survey.
[10] Dennison Dam on Red River with ultimate capacity of 175,000 kw installed, 15,000 kw firm power, possible by 1944, not included.
[11] Part of Lower Colorado River Authority development.
[12] Reported by Brazos River Conservation and Reclamation Districts.

Count on Copes TO HELP YOU WIN THE VITAL BATTLE OF PRODUCTION...

YOU can get more steam from your present boilers with COPES feeding water exactly as needed for your load and furnace conditions—no matter how rapidly or widely they might change.

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You can reduce to a minimum the outages chargeable to high or low boiler water—for the COPES controls boiler water level within close, safe limits always.

You can put operators to doing more useful work than watching the boiler water level—for the COPES is fully-automatic and needs no more than routine care.

And if demands of the defense program make it urgent for you to add new boilers, COPES will help you get them on the line more quickly.

COPES controls are made to measure for your needs—not taken from stock. It now takes a little longer to build them than in pre-emergency days before foundries, machine shops and assembly lines became so busy. But our plant has been expanded to meet the increasing demands, and we can meet almost any reasonable shipping date you specify.

Your operators can cut the COPES into service—no factory experts needed—and forget about feed and level control while they coordinate your other boiler controls and auxiliary equipment.

These are the ways COPES Regulation can help you win the vital battle of production in your own plant—and your investment need be but a modest sum. Write for complete information about *fully*-automatic COPES Control.

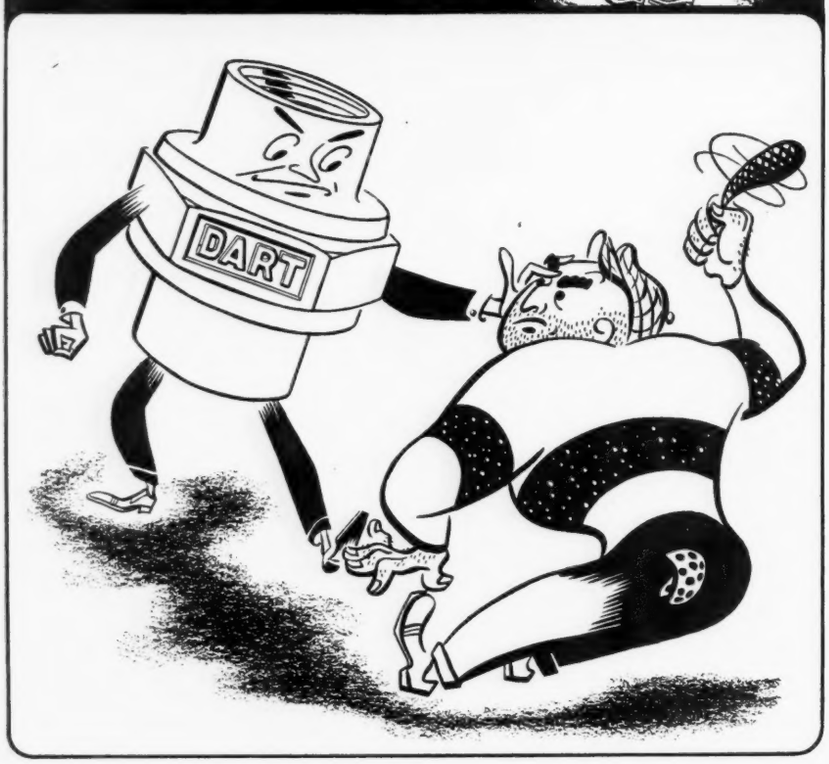
NORTHERN EQUIPMENT COMPANY
911 GROVE DRIVE, ERIE, PENNSYLVANIA

Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters

★ GET CLOSER LEVEL CONTROL WITH THE COPES FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY FLOW-MATIC ★ REGULATOR

DART UNIONS

RESIST
Rough Handling and Abuse



DART UNIONS won't take a licking from the *toughest* conditions. They're made of stern stuff . . . their matched seats, in fact, are made of *bronze*, ground to accurate "true-ball" surfaces—nuts and bodies are made of air refined malleable iron. This explains why Dart Unions are able to make up tight so quickly, stay tighter longer, be installed time and again. It also explains why Dart Unions can stand up against and KO wrench abuse, pipe strains and corrosion.

If you are not using Darts now, try them soon. You'll be very glad that you did.

DART UNIONS

E. M. DART MFG. CO., Providence, R. I.

Sales Agents: The Fairbanks Company, New York, and all branches
Canadian Factory: Dart Union Company, Ltd., Toronto, Canada

Power Lines

Help Maintain Source of Supply

By PHIL SWAIN, *Editor*

Here's a new situation vitally affecting power engineers everywhere, but not understood by many of them. If you are an engineer in charge of any kind of operation you are buying certain specialties and supplies "off the shelf", either direct from the manufacturer or from a distributor. I refer to such items as tools, piping, fittings, valves, traps, packing, etc. For the sake of productive efficiency these are generally made by the manufacturer for stock.

But raw materials are getting scarce these days, so only materials for authenticated defense jobs are getting the green light from the Office of Production Management. That leaves the man who makes goods for stock in a pretty pickle. How can he tell whether a certain piece is for defense when he makes it before he gets the order?

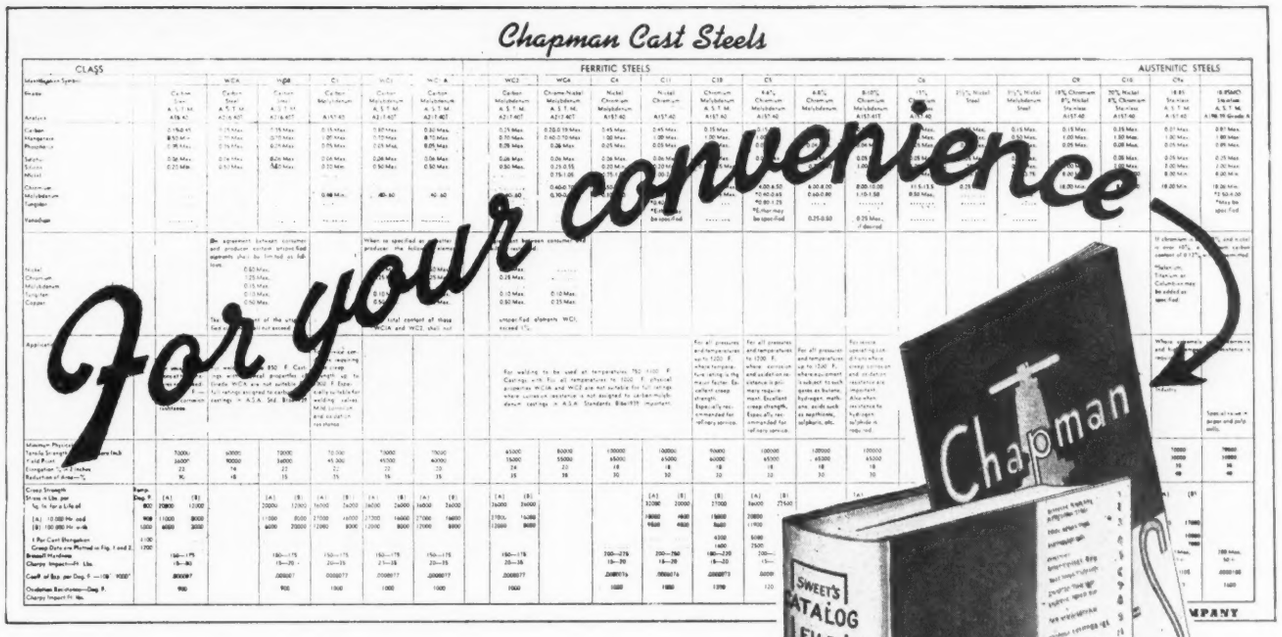
To keep some control over this off-the-shelf business, OPM now requires the manufacturer to determine what percentage of his orders is for defense projects. With this in hand he is granted a rating on that portion of his raw material requirements. He must get the proof from his customers.

So you, the customer, get a questionnaire from the manufacturer or distributor asking whether the stuff you bought was for defense or not. No one can make you answer this questionnaire, but if you don't, and if enough others don't, the manufacturer won't be able to get his steel and other materials for these items. Then when you need some more goods from his stocks, you won't be able to buy any, not even for a defense job, because the cupboard will be bare.

As a matter of pure self-interest, as well as patriotism, we suggest that buyers promptly sign the Defense Supplies Rating Plan affidavits submitted by suppliers, relating to the defense use of goods purchased.

New Plant for Westerly, R. I.

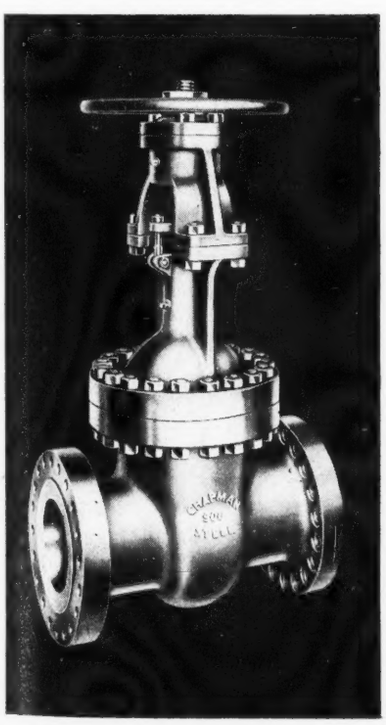
Narragansett Electric Co, a New England Power Association subsidiary, has announced that construction will be started as soon as possible on a steam



Catalog Information on

CHAPMAN VALVES

Is Filed in Sweet's 1941 Catalog for Power Plants



Comprehensive catalog information on standard lines of Chapman Iron, Bronze and Steel Valves is filed for your convenience in the 1941 edition of Sweet's. The information is concise and orderly, giving only pertinent facts and data necessary for intelligent selection of valve equipment. The section on Chapman Steel Valves is notably complete and up-to-date. The various types of valves and fittings are arranged by pressure groups, with essential diagrams and tabulated dimensions for each group. Special attention is called to the chart on Chapman Cast Steels, tabulating the chemical and physical properties and recommended applications for each of the wide range of Chapman Alloy Steels. Copy of this Chart, or reprints of any or all the Chapman catalog sections, will be mailed on request.

THE CHAPMAN VALVE

Manufacturing Company

INDIAN ORCHARD, MASS.

Measure Speed — Simply by Touch

Consider the advantages of a Portable Hand Tachometer that does not even "see" the rotating shaft, that has no wearing parts or pointer, that requires no belts, gears or electrical connections and that cannot lose its calibration through lack of oil or over-speeding.

Simply hold the Frahm Tachometer against some stationary part of the machine under test. Almost immediately one of the calibrated reeds begins to vibrate and the corresponding point on the scale shows the speed.

It works by mechanical resonance. Slight vibration of the machine passes into the instrument through the point of contact and the particular reed which is in tune goes into responsive vibration.

This unique device may help to solve your speed-measuring and vibration problems. Made for both hand use and for permanent mounting, ranges from 900 up to 30,000 r. p. m.

Write for Bulletin 1590P

JAMES G. BIDDLE CO.

1211-13 Arch Street, Philadelphia, Pa.

"FRAHM" Vibrating Reed TACHOMETER

station at Westerly, about 45 miles southwest of Providence. Two 10,000-kw Allis-Chalmers condensing turbine units will be installed, running at 3,600 rpm, with 650-lb, 825-F. steam.

The plant is to be completed by December, 1942, according to delivery dates now in effect. A new building 145 ft x 100 ft will be erected, and the station will be on tidewater. Growth of load in the South County district, including defense industries and the Quonset naval air base requirements, led to the decision to build this station. It will be Narragansett's first outside Providence. Boiler equipment is to be ordered shortly.

W F Crawford New Edward Valve Head

W F Crawford, vice president of Edward Valve Mfg Co, East Chicago, Ind., has been elected president, filling the position made vacant by the death of his father, William W Crawford, some months ago. The new president was

W F Crawford

formerly in charge of research and sales-promotion activities, as well as manufacturing and advertising. He is a member of numerous technical societies, and has been associated with Edward Valve Mfg Co for approximately eleven years.

Plans for Hydro Station Submitted

Detailed plans for a hydro-electric generating station on the American side of the Niagara River to develop 1,227,000 hp, or more than the amount than would be generated by the St. Lawrence Seaway and power projects, have been sent to Washington by Louis A Harding, public works commissioner of the City of Buffalo.

The report was designed to answer seaway proponents' claims that the sea-

The makers of famous

PHOENIX HOSIERY...

Engine room, Phoenix Hosiery Mill, Milwaukee

...rely for POWER on economical COAL!

POWER for the whirling spindles and turning wheels...steam for the dye and other process vats . . . the Phoenix Hosiery Company, world's largest manufacturer of men's, women's and children's hose, makes great and steady demand on its power plant. And what is the fuel that keeps this industry going at its Milwaukee mill? COAL —modern, prepared coal. "We burn coal," says Mr. L. H. Stark, the Plant Engineer, "because we find it a completely *dependable* fuel . . . maintaining high boiler efficiencies at an obvious saving in cost per thousand pounds of steam."

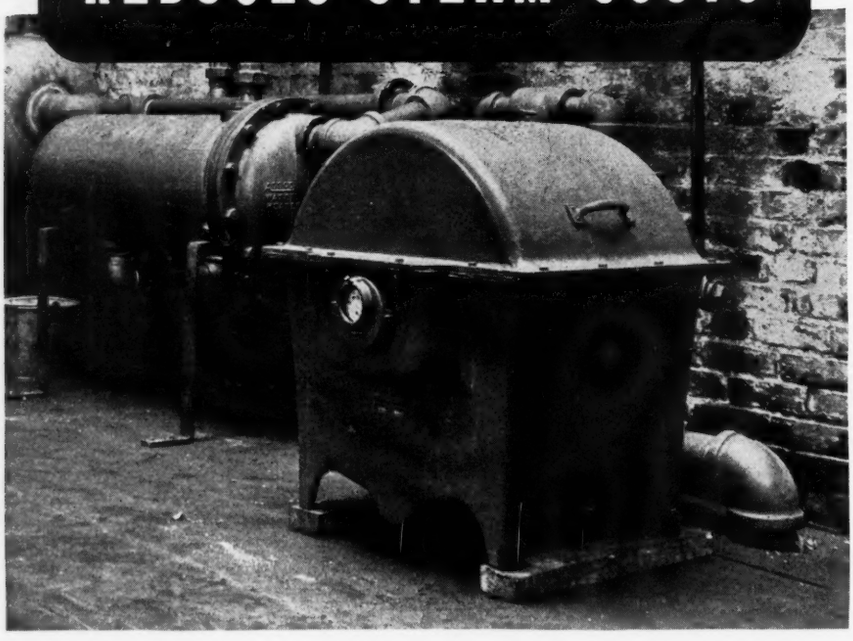
ARE YOU OVERLOOKING ECONOMIES AT YOUR PLANT?

Perhaps *your* plant can't be run more efficiently and cheaply than it now is. But perhaps it can. Wouldn't it be worthwhile to find out—particularly if this involves you in no expense? That's what the Fuel Service Engineers of Chesapeake and Ohio Lines are for . . . to help industrial executives with fuel and power problems. If you'd like our Engineers to call at your plant, make a survey, consult with your engineers and make suggestions for higher efficiency and greater economies, simply write GEORGE H. REINBRECHT, Coal Traffic Manager, Chesapeake and Ohio Lines, 2901 Terminal Tower, Cleveland, Ohio. It won't place you under obligation!

IT PAY$ TO U$E MODERN...

Chesapeake and Ohio Lines

METERS STEAM CONSUMED
DETECTS STEAM WASTE
REDUCES STEAM COSTS



ADSCO

ROTARY CONDENSATION METER

To totalize steam consumption whether per day or per month—per building or department, to track down steam waste and stop it at its source, the ADSCO Rotary Condensation Meter has no equal.

It gives you the facts accurately, economically, continuously—has saved scores of users hundreds of steam dollars annually.

Get the full facts on the low cost of policing your steam lines with this low cost, high efficiency meter.

Write for Bulletin 35-80PR.

AVAILABLE IN 7 SIZES —250 TO 12,000 LBS. FOR VACUUM OR GRAVITY INSTALLATION

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, N.Y.
IN BUSINESS OVER SIXTY YEARS

way would be needed to generate cheap power.

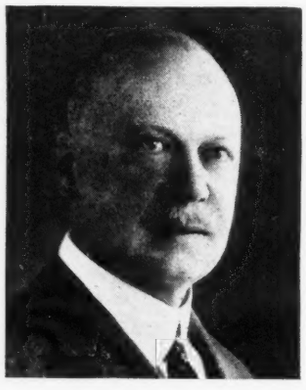
The Harding proposal provided for diversion of 40,000 additional cubic feet per second of water from Niagara River at LaSalle, N. Y. and its transmission through a 42,000-foot-long canal to the west of Niagara Falls and back into the river near Devil's Hole. The total cost would be about $85,159,111.

Frederick Felderman Dies

Frederick Felderman, 72, died August 10 at Mary Immaculate Hospital, Jamaica, N. Y. "Grand Old Man" of the National Association of Power Engineers, Mr Felderman has received all possible honors from that group. He was past national president, past president, N. Y. State Association and past president of Stevenson Association, No. 44, New York City.

Born in Germany, Mr Felderman went to sea as a young man and served long as a marine engineer, seeing much of this service on British ships.

He settled in the United States and became an American citizen in 1892. For many years he was chief engineer of the New York Municipal Ferries, and later of the Washington Market. His NAPE connections started in 1898, since which time he has been continuously active, even since his retirement from plant operation three years ago. He has attended without a break every NAPE national convention for the past 43 years.



Fred Felderman

"Fred" Felderman will be long remembered by thousands as a great orator, a man of outstanding masculine personality, a most loyal supporter of the NAPE and a true friend of power engineers everywhere.

OBITUARIES

ROBERT L LAVAN, 74, for many years employed as a stationary engineer in the Niagara Falls, N. Y. city hall, died July 30 at Wellsboro, Pa. A resident

Why everyone with a hand in plant piping prefers

TUBE-TURN *Welding Fittings*

Naturally, you are *most* interested in the particular ways that Tube-Turns help *your* department and *your* problems. You'll find them in the above illustration.

But go further. Note the equally strong advantages that Tube-Turn welding fittings offer to *all* departments in your plant that are concerned with piping.

By viewing here *all sides* of the Tube-Turn story, you see *why* Tube-Turns have earned ever-increasing preference—constantly wider applications—and the leadership held since their *origination* of the welding fitting idea.

There's a Tube-Turn for *every* welding fitting need, in all types, sizes and weights. Write for helpful catalog and data book. TUBE-TURNS, Inc., Louisville, Ky. Branch offices: New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Los Angeles. Distributors everywhere.

TUBE-TURN TRADE MARK

★ The ★ FIRST WELDING FITTINGS 1ST AND STILL THE BEST

Welding Fittings

CLIP AND SEND . . .

. . . THIS MEMORANDUM TO YOUR ENGINEER IN CHARGE OF BOILER OPERATION

Please give me the facts about "BAERITE"

SIMPLIFIED WATER TREATMENT FOR BOILERS AND CONDENSERS

QUESTIONS

TO DISCUSS ABOUT YOUR POWER COSTS

- Is your present water treatment doing the complete job "Baerite" will do?
- Can you safely operate 300 days between boiler inspections—and have no delays or complaints?
- Is your present boiler water treatment assuring you against rust, scale and pitting indefinitely?
- Can you honestly face the present power crisis without investigating the "Baerite" Water Treatment first?

FACTUAL DATA

We will gladly send to you or your engineer in charge of boiler operation, complete factual data on "Baerite" Water Treatment for boiler feed waters or condensers. "Baerite" may still be new to you, but it is time-tested and proved. Just drop a line today. There is no obligation.

WATER TREATMENT COMPANY of AMERICA

1161 HODGKISS STREET PITTSBURGH, PENNA.

Sales and Service in Key Cities

of Niagara Falls for the last 40 years, Mr LaVan worked for the city about 20.

OWEN F TREAT, assistant manager of the Boston branch, Jenkins Valve Co, died at his home in Milton, Mass., on July 25. He was a native of Vinal Haven, Me.

HARVEY C COUCH, 63, former head of the Arkansas Power and Light Co and Kansas City, Southern-Louisiana and Arkansas Railway Lines, died at his summer home near Hot Springs, Ark., on July 30. He had been in ill health for a year and critically ill for a few days.

STEPHEN B ANDREWS, comptroller, Goulds Pumps, Inc, passed away July 19, 1941.

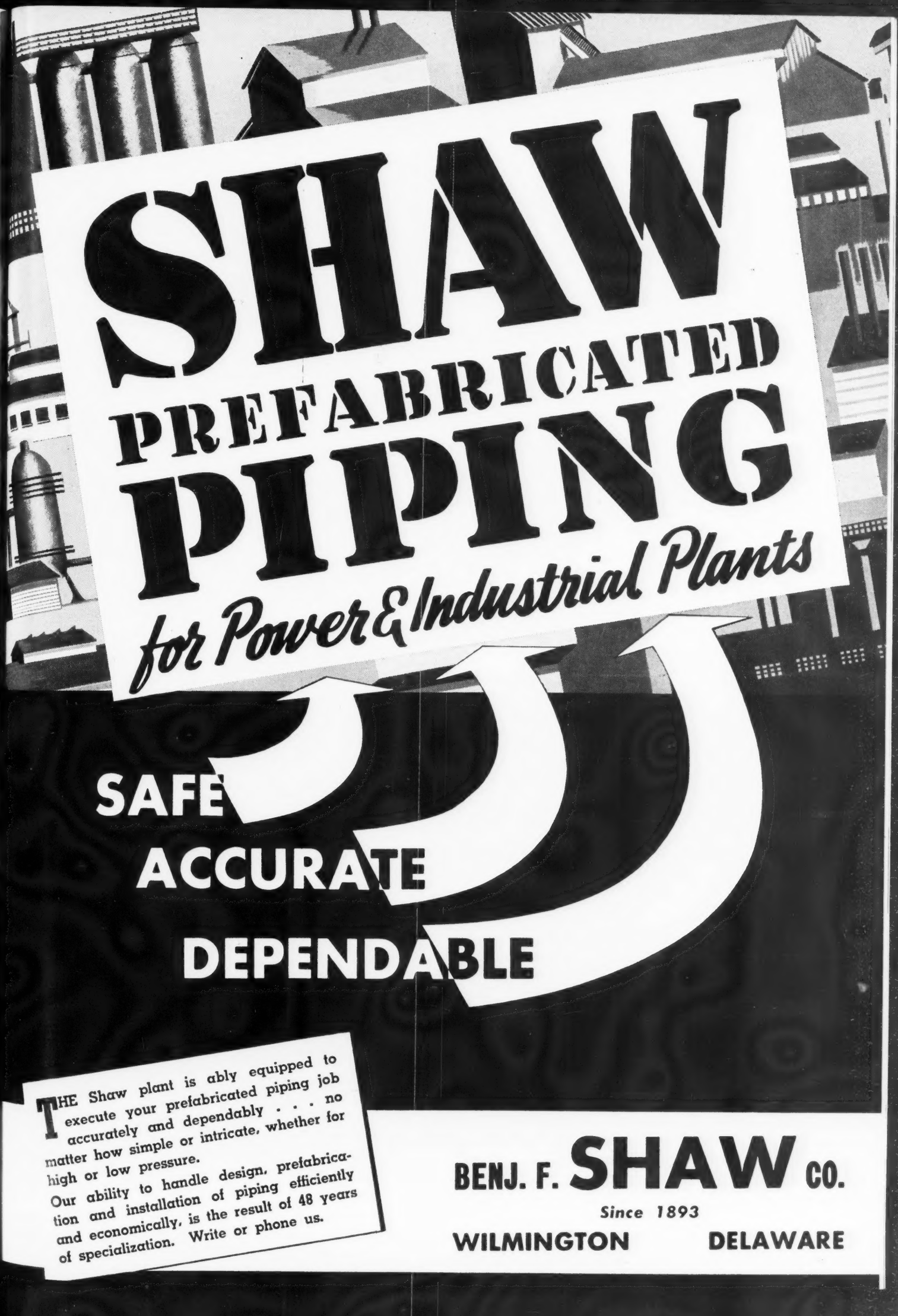
BROOKS FAXON, 67, formerly New England manager of Wagner Electric Corp, and for many years an advocate of sound competition in sales engineering, died at York, Me., on July 17. He was widely known in industrial, electrical, and power-plant circles in the northeast.

WILLIAM SPALDING, 69, stationary engineer for 50 years, died July 24 at Millard Fillmore Hospital, Buffalo, N. Y. He was employed at the Massachusetts Ave pumping station, and had received his 50th engineer's license this year. He was born in London, came to Canada when he was 15, and to Buffalo shortly afterward. He was an engineer at the Buffalo General Hospital for 30 years.

PERSONALS

SAMUEL SHELLGREN, 76, engineer at the plant of Crawford Furniture Mfg Corp at Jamestown, N. Y., was presented recently with a gold watch in recognition of 50 years of service. Presentation was made by Clyne Crawford, president, who commended Mr Shellgren on his half-century of company service. Mr Shellgren was born in Sweden, came to this country in 1890. He started to work for the Atlas Furniture Co, which later became the Crawford Co, and has been employed there ever since.

J B WALKER has been appointed sales manager of Transportation and Generator Div, Westinghouse Electric & Mfg Co. Mr Walker has been employed by the company since his graduation from University of Arkansas in 1925. He was first a graduate student, then



THE Shaw plant is ably equipped to execute your prefabricated piping job accurately and dependably . . . no matter how simple or intricate, whether for high or low pressure.

Our ability to handle design, prefabrication and installation of piping efficiently and economically, is the result of 48 years of specialization. Write or phone us.

BENJ. F. SHAW CO.

Since 1893

WILMINGTON DELAWARE

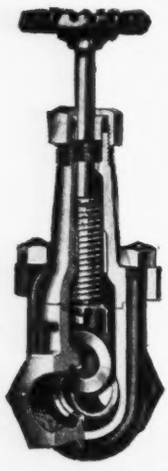
Comes Apart in a Jiffy!

A U-bolt firmly locks together the body and bonnet of Fairbanks U-Bolt Gate Valve, making a pressure-tight joint adding strength to the body. By removing only two nuts the valve can be easily and quickly taken apart for inspection or cleaning.

To prevent freezing or clogging above bonnet threads and permit draining back into body, it has relief slots in bonnet bushing.

To insure a tight seat and permit repacking under pressure without leakage, seat is above stem threads. This also prevents sediment reaching and scoring seating surfaces.

The heavy rolled-bronze stem has more than five full-cut Acme threads always in contact with bonnet. Body and bonnet are made of high-test iron with an average strength of 40,000 lbs. per sq. in.



Double-taper wedge, with knife edge, cuts through heavy fluids and sediment.

These are but a few of the advantages of U-Bolt Valve 0417. Made for 150 lbs. steam, 225 lbs. gas and liquid pressures, in sizes ½″ to 4″. Sold by distributors everywhere. Write for booklet No. 30.

THE FAIRBANKS COMPANY

397 Lafayette St., New York, N. Y.

Boston, Mass. **Pittsburgh, Pa.**

Distributors in Principal Cities

Factories: Binghamton, N. Y., Rome, Ga.

FAIRBANKS U-BOLT GATE VALVES

J B Walker

central station sales correspondent. In 1939 he was appointed manager of the Generator Section of the division, continuing in that position until his present appointment.

WILLIAM B BROADBENT has been appointed superintendent of the Operating Dept, Southern Div, New England Power System, succeeding the late Trefley C Capistron. His headquarters will continue to be at Providence, R. I. Frank M Lucas succeeds Mr Broadbent as assistant superintendent of the division.

RICHARD B ENGDAHL has joined the research staff of Battele Memorial Institute, Columbus, Ohio. He has been assigned to the division of fuels research and will assist in an investigation of the use of pulverized fuel for firing of ceramic and metallurgical furnaces.

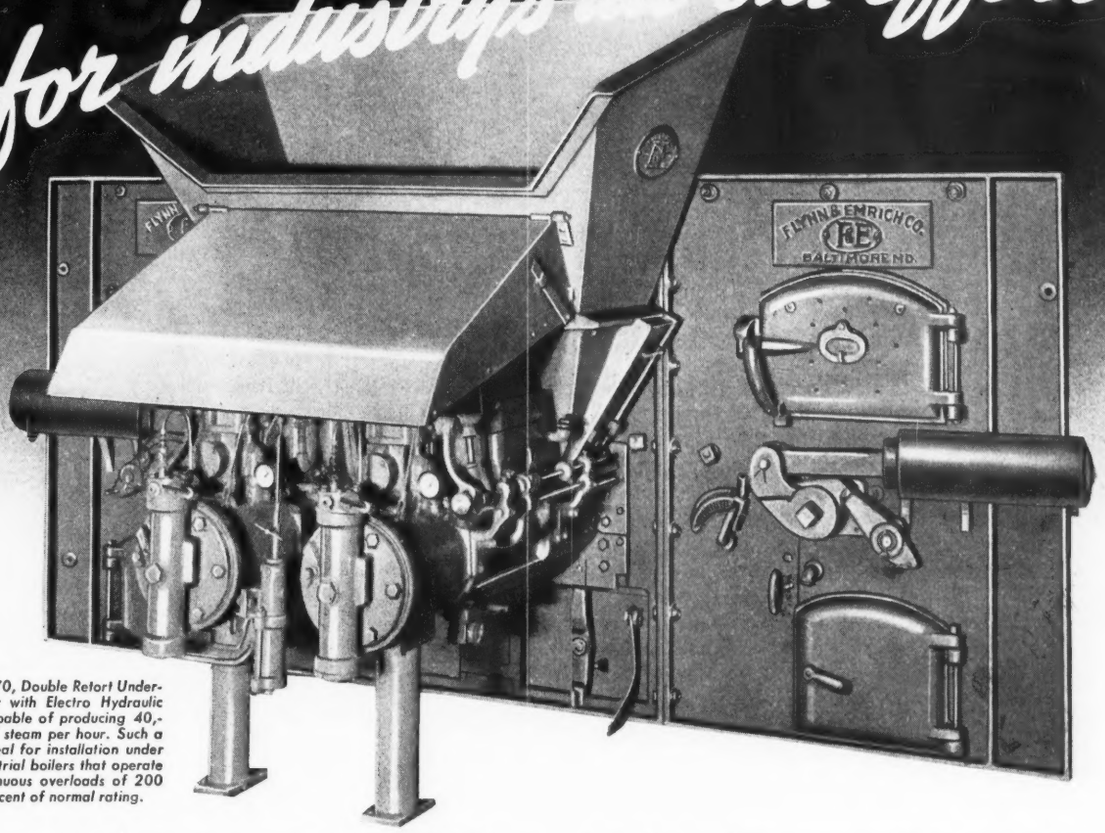
DEWEY ABELL, chief engineer of generating plant for the Lawrence Gas & Electric Co since 1906, recently received a 55-year service pin from Carl S Herrmann, president of the New England Power Association, in recognition of the longest term of employment of anyone in the system. Mr Abell joined the then Lawrence Edison Co in 1886 as an oiler at the Common St Station, becoming an operating enginer four years later.

BERTRAND A LANDRY has joined the staff of Battelle Memorial Institute, Columbus, Ohio, where he is engaged in research and development work in division of fuels research. A graduate of Massachusetts Institute of Technology and Carnegie Institute of Technology. Mr Landry was associated for 18 years with the U. S. Bureau of Mines prior to his joining the Battelle staff.

J M BOWLBY has been elected president of the Eagle-Picher Lead Co, to succeed Joseph Hummel, Jr. Mr Hummel, who has been associated with

DEPENDABLE POWER

for industry's all out effort



This Series 70, Double Retort Underfeed Stoker with Electro Hydraulic Drive is capable of producing 40,000 lbs. of steam per hour. Such a stoker is ideal for installation under heavy industrial boilers that operate under continuous overloads of 200 to 250 per cent of normal rating.

For twenty–five years "F & E" Stokers have fulfilled a promise of dependability to American Industry. Day in and day out they have been on the job through depression and boom, proving their value, paying for themselves over and over again. Today when Industry is engaged in unparalleled activity in the "all out" National Defense Program, "F & E" Stokers stand ready to do their full part.

F&E STOKERS

Hydraulic And Steam Drive are manufactured and sold by

FLYNN & EMRICH CO., BALTO., MD.

Representatives in Principal Cities

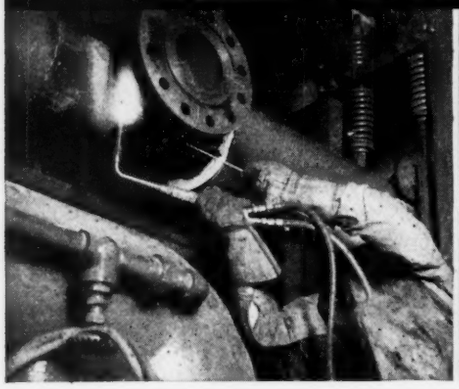
★★ There is an "F & E" Underfeed Stoker for every boiler that produces from 1,000 to 40,000 pounds of steam per hour for power or heat--industrial or commercial. Complete literature available. ★★

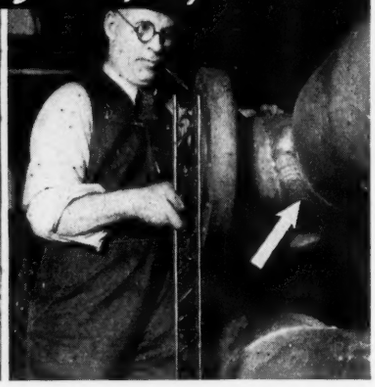
WELDOLETS·

TRADE MARKS - REG. U. S. PAT. OFF.

THREDOLETS

. . . Welded Outlets for Piping . . .





Welded Branch Pipe Connections Without Distortion

ONLY with a Bonney WeldOlet could the above installation have been made without taking down the main pipe. The 6" branch line was connected into the 8" main without disturbing the main in any way and after the flange had been welded into position it was absolutely square.

Bonney WeldOlets and/or ThredOlets make difficult installations of this kind easy. They save money in their installation and reduce the time of costly shut-downs and production stoppages.

They are recommended for all commonly used pressures and temperatures in every type of piping installation.

In addition to tremendous savings in time and labor cost of installation, Bonney WeldOlets and/or ThredOlets provide the additional advantages of lifetime, leakproof joints of full pipe strength and improved flow conditions. Any welder of average experience can do a perfect installation job quickly and easily.

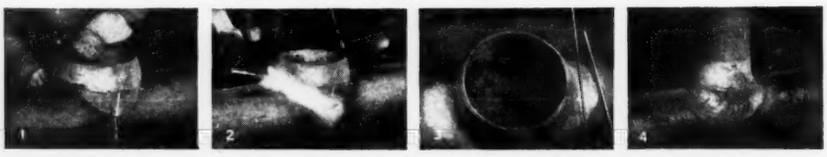
For maintenance, renovation or new construction, WeldOlets and/or ThredOlets will give you improved piping efficiency at lower cost. Bulletin WT29 gives complete details of all their advantages. Write today for your copy.

WeldOlet

ThredOlet

Socket-End WeldOlet

As Easy As Lighting Your Pipe



(1)—Select the position of the outlet, rub the fitting over the pipe several times to remove scale, mark center lines and tack the WeldOlet or ThredOlet into position. (2)—The fitting is then welded into place by the electric-arc or oxy-acetylene method. A junction of full pipe strength and a leak-proof joint is the result. (3)—Where the outlet is 2" or larger the button should be removed after the welding operation. On small sizes the fitting is used as a templet and the hole is cut in the main pipe first, either with a hole saw, the torch or by drilling. Inspection of the inside of the joint is possible by using WeldOlets and/or ThredOlets, allowing the removal of all scale, welding metal, etc. (4)—The branch line is then welded into position. In the event that a ThredOlet is used the branch pipe is threaded and screwed into place.

BONNEY FORGE & TOOL WORKS

Forged Fittings Division - Allentown, Pa.

Forged by the Makers of

The Finest that Money Can Buy

BONNEY TOOLS

J M Bowlby

Eagle-Picher for 50 years, had asked to be relieved of his duties, and was elected chairman of the board.

R H Olson, New York district manager of sales since 1929, has recently been appointed Eastern sales manager of Electric Machinery Mfg Co. He has been associated with the company for 25 years, having previously been in charge of Minneapolis and St. Louis district sales.

F G Gardner, of the engineering staff of Kellogg Switchboard & Supply Co has been selected to fill position of acting chief engineer, replacing George R Eaton, taking a leave of absence on advice of his physician. As a member of Kellogg staff, Mr Gardner has been engaged in special transmission engineering work.

BUSINESS ITEMS

Peerless Pump Div, Food Machinery Corp, announces removal of Eastern offices and manufacturing facilities from Massillon, Ohio to new plant located at 1250 Camden Ave, S.W., Canton, Ohio. Plant remains under same general management as Los Angeles plant, Vernon Edler being vice-president and general manager.

Foxboro Co announces change of address of St. Louis, Mo., office. New address is 3615 Olive St. E B Miller is manager of new office. George B Ewing, Jr, has joined staff of sales engineers attached to Houston, Texas, office.

Fedders-New York Co, 415 Lexington Ave, New York, N. Y., has been formed to represent several companies' line of heating and ventilating equipment. Companies represented are Fedders Co, New York Blower Co and Scott Valve Mfg Co. John C. Kierner and

Bartlett·Snow

SKIP HOISTS

—meet every requirement for handling coal, also ashes, limestone and other abrasive materials when the lift is high, capacities large, and a minimum of care and maintenance are desired. Standard and special designs to provide any hourly tonnage capacity. Eng. Bul. No. 83, sent on request, gives full details. The C. O. Bartlett & Snow Co., 6205 Harvard Ave., Cleveland, Ohio.

One of the two Schramm direct drive stationary compressors supplying air for miscellaneous production requirements.

A LOT OF AIR—at low cost—IN A LITTLE SPACE

This modern Schramm unit—supplying compressed air in a large Industrial plant—is a duplicate of one furnished this nationally known manufacturer three years ago.

Note the compact size of the unit by comparison with the man standing by. Smooth, vibration-free performance is also evident from the sharpness of the photograph taken while the compressor was running at full speed supplying 300 cu. ft. of air.

These units are available in a wide range of sizes with motor, V Belt or direct drive.

SCHRAMM COMPRESSOR VALVES

Positive valve action of Schramm Compressors is assured by mechanical intake valves. This feature, which contributes to trouble-free performance by providing exact timing, also assures delivery of air at the rated capacity of the compressor.

Send for Bulletin No. 3907 giving detailed information.

SCHRAMM, INC., WEST CHESTER, PA.

SCHRAMM UTILITY STATIONARY AIR COMPRESSORS

Eugene C. Moran will be in charge of the new company.

WARREN WEBSTER & Co announces appointment of D F Bennett as manager of Radiation and Unit Heater Div of Webster Sales Dept. He replaces Clarence E Scott, who has resigned to accept a position as sales manager of Fedders, Inc.

BURY COMPRESSOR Co has appointed Allan T Shepherd Co, Richmond, Va., district representative for Virginia and North Carolina. Announcement also made of appointment of following representatives: John A Dodd Co, Atlanta, Ga., to cover Atlanta, South Carolina, and Florida; R E Boggs, Birmingham, Ala., entire state of Alabama; C G Forshey, Houston, Texas, entire state of Texas; Menge Pump & Machinery Co, New Orleans, La., covering Louisiana and Mississippi; W R Fithian, Kansas City, Mo., covering Western Missouri and Kansas; and Lane Machinery Co, St. Louis, Mo., eastern part of Missouri and southern Illinois.

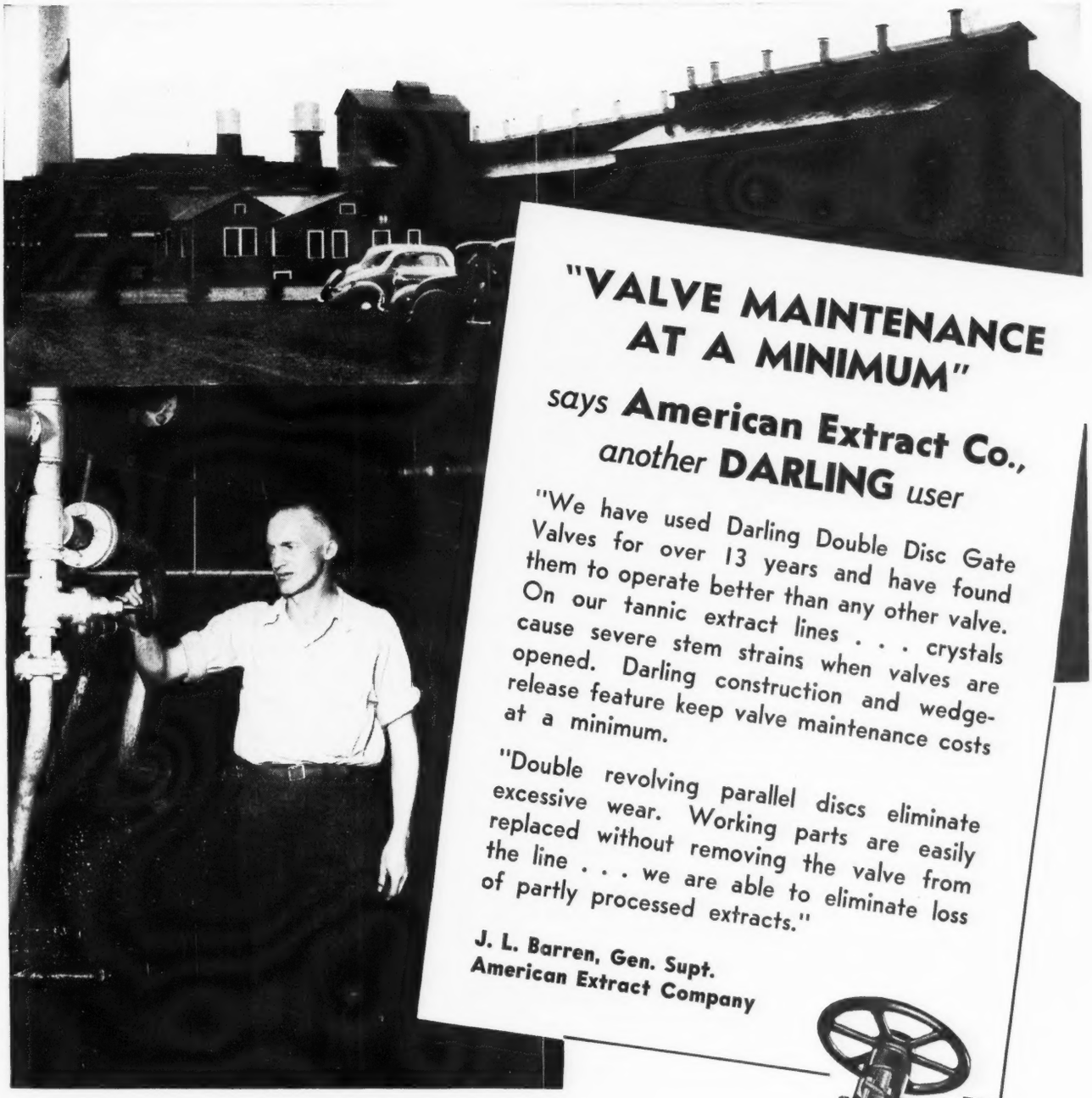
WATSON-STILLMAN Co announces organization changes. W W Gilbert, formerly advertising manager, will be made general office manager of Fittings Div. All Advertising Dept activities will be taken over by agency, O S Tyson & Co, 230 Park Ave, New York. Fay Keyler, vice-president of O S Tyson & Co, will have charge of company advertising, acting as advertising manager, with office at Roselle, N. J. headquarters, during part of the week.

HELE-SHAW PUMP DIV, AMERICAN ENGRG Co, Philadelphia, Pa., announces appointment of R S Ernst to represent them in Indiana, Wisconsin and part of Illinois.

ELLIOT Co, Jeanette, Pa., announces resignation of James E Watson as president and member of the board of directors, effective July 31. L M Forncrook, vice-president, will act as operating head of company until a successor is named.

FEDDERS MFG Co announces promotion of Edmund R Walker to assistant general manager of company. He was formerly manager of the company's Air Conditioning Div.

CUTLER-HAMMER, INC, announces transfer of C G Skidmore from New York to Philadelphia. Previous to his association with Cutler-Hammer, Mr Skidmore was employed by the U. S.



"VALVE MAINTENANCE AT A MINIMUM"

says **American Extract Co.,** *another* **DARLING** *user*

"We have used Darling Double Disc Gate Valves for over 13 years and have found them to operate better than any other valve. On our tannic extract lines . . . crystals cause severe stem strains when valves are opened. Darling construction and wedge-release feature keep valve maintenance costs at a minimum.

"Double revolving parallel discs eliminate excessive wear. Working parts are easily replaced without removing the valve from the line . . . we are able to eliminate loss of partly processed extracts."

J. L. Barren, Gen. Supt.
American Extract Company

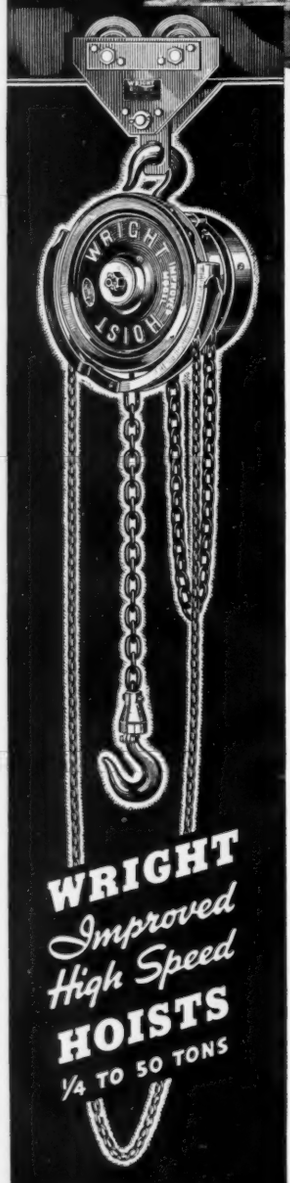
Letters like this speak for themselves as evidence of Darling advantages—long life, easy operation, low maintenance costs.

Darling Gate Valves for every purpose are available in cast steel, forged steel, cast iron, bronze and in a wide range of alloys specially developed for use under severe service conditions.

DARLING
DENSE-METAL GATE VALVES

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT, PA.

Representatives in:
New York Philadelphia Houston Toledo Pittsburgh Huntington, W. Va. McPherson, Kan.



● ***Speed—economy—safety!*** That's the demand of American industry today. And the **Wright Improved High-Speed Hoist** is one of the answers to that demand.

In the first place, the inclusion of the words "High Speed" in the WRIGHT HOIST name is a statement of fact. They mean what they say. The WRIGHT HOIST *is fast,* smooth and positive in action—because of its load wheel and driving spindle bearings.

Wright's economy comes through its rugged and precision design—its year-in and year-out durability.

And safety is inbuilt. The load chain has a safety factor of 7 to 1 and the special process steel of which it is made permits the chain to elongate (because of overload) 3″ to the foot before breaking. This same visual factor of safety is inherent in the bottom hook because this hook will slowly open to indicate overload beyond the elastic limit of the chain.

WRIGHT TROLLEYS are made to give the same fast—economical—safe service as WRIGHT HOISTS.

WRIGHT MANUFACTURING DIVISION
YORK, PENNSYLVANIA

ACCO

AMERICAN CHAIN & CABLE COMPANY, Inc.
In Business for Your Safety

Bureau of Reclamation as a design engineer on control for power-plant equipment.

E F Houghton & Co, recently announced appointment of W A Fletcher as district sales manager for Western Div. He will maintain his headquarters at 835 Harrison St, San Francisco and will be in charge of sales in California, Oregon and Washington.

Copperweld Steel Co announces election of Thomas F Troxell as treasurer and a director. Sidney D Williams, formerly vice-president in charge of steel sales, has been made executive vice-president in charge of Warren, Ohio, Div. William B Klee, Jr, assistant secretary, has also been made assistant to the executive vice-president.

United Illuminating Co has promoted Fred Bodington, assistant chief engineer for four years, to chief engineer. Two assistants have also been named: Daniel J Esposito of the company's chemical laboratory, and Robert L Williams of the general maintenance department.

E J Cheney & Co has opened offices at 61 Broadway, New York, N. Y., as engineers and consultants for power plants, industrial plants, refineries, defense projects, etc.

International Chimney Co, Washington, announces association of Hugh B Roarke with organization, effective July 1, 1941.

CALLING MR EMERY!

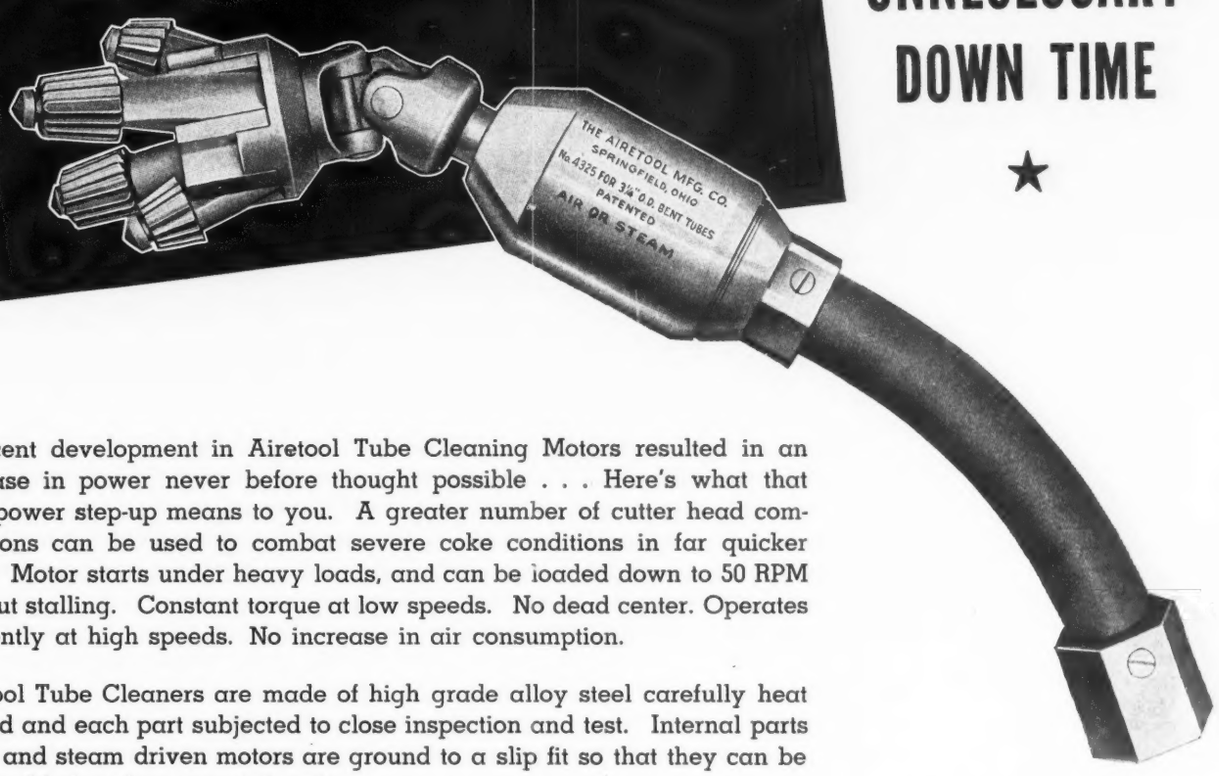
Recently Nelson F Emery wrote in commenting on page 110, July Power, asking some questions. Editor Swain has prepared the answers to these questions but cannot send them to Mr Emery because Mr Emery didn't give his address. We await this information.

To High-Speed Steel Users

Because of the tungsten shortage, the Office of Production Management is promoting the use of molybdenum high-speed steels. This in turn has led to a demand for instructions for heat treating such steel for greatest efficiency; so OPM has named three committees to investigate and report. These reports will be passed on by other experts, revised, printed and distributed to all interested persons. Any Power readers, or their industrial associates, who could

(Continued on page 170)

TERRIFIC POWER



★ YOUR DEFENSE AGAINST UNNECESSARY DOWN TIME ★

A recent development in Airetool Tube Cleaning Motors resulted in an increase in power never before thought possible . . . Here's what that 28% power step-up means to you. A greater number of cutter head combinations can be used to combat severe coke conditions in far quicker time. Motor starts under heavy loads, and can be loaded down to 50 RPM without stalling. Constant torque at low speeds. No dead center. Operates efficiently at high speeds. No increase in air consumption.

Airetool Tube Cleaners are made of high grade alloy steel carefully heat treated and each part subjected to close inspection and test. Internal parts of air and steam driven motors are ground to a slip fit so that they can be reassembled without special tools.

Airetool Tube Cleaners are made in all sizes from ½" I.D. to 20" I.D. There is an efficient Airetool Cleaner for every type bent or straight tube. Cutter heads, brushes, drills or knocker heads are available for efficient removal of any deposit. Your file is not complete without our new Bulletin 14. FREE ON REQUEST. SEND TODAY.

NEW DEVELOPMENT

Here's a new development that means far longer life to expanding brush type heads. Lower illustration shows a typical Airetool Tube Cleaner with Brush. Encircled is a newly designed expanding segment for brush heads. Tufts are in a solid metal base. They cannot be pushed out as in other type brushes. Result: Fewer replacements; lower maintenance cost. Write for details.

Airetool MANUFACTURING COMPANY
SPRINGFIELD, OHIO

RUNNING 24 HOURS?
BURNING MORE COAL?

Then get your money's worth of B.T.U.'s

. . . BY ANALYZING WITH THE IMPROVED STURTEVANT AUTOMATIC COAL CRUSHER AND SAMPLER . . .

Now's the time to do what most big coal consumers do—*sample your coal* to insure maximum performance and economy.

The "Sturtevant Way" provides a simple method of preparing samples for analysis, saves hand labor, avoids delays and prevents inaccuracies.

The Sturtevant Machine crushes 3" and smaller coal and coke at the rate of 1 ton per hour to 8 mesh and finer, and automatically picks out truly representative 5, 10 or 15% samples of all coal or coke passing. This method actually eliminates 32 of the 34 slow, inaccurate steps involved in hand sampling. Massive construction, simplicity and slow speed insure long life and low maintenance. Only 3 HP required to operate.

Write today for Bulletin 85—sent FREE on request.

WHAT A FEW USERS SAY . . .

. . . "the personal equation has been entirely eliminated"

. . . "savings average $6000- over non-sampling in 100,-000 tons"

. . . "has paid for itself through elimination of evaporation of moisture during preparation"

. . . "gives us more representative sample"

FOR SAVINGS . . .

"SAMPLE YOUR COAL BEFORE YOU BURN IT"

Sturtevant Mill Co.

103 Clayton St., Dorchester, Boston, Mass.

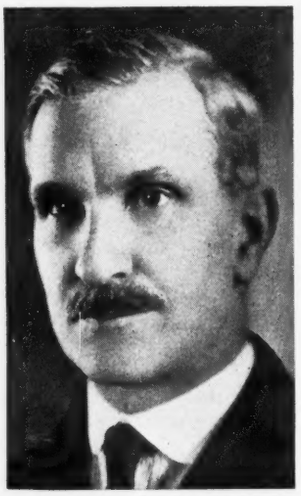
(Continued from page 166)

profit by these reports when they are ready should write to

Bradley Stoughton
Chief, Heat Treating Div
Tools Section
Room 3425, Social Security Bldg
Washington. D. C.

G L Markland Passes

George L Markland, Jr, 75, chairman of the board of the Philadelphia Gear Works, died in Jefferson Hospital, Philadelphia, on Aug. 14. He was widely known throughout the machine-tool industry and the metal-working industry in general, and his character and keen sense of humor won him many friends.



George Markland

He gained a high reputation through his management of the Philadelphia Gear Works, which he purchased in 1911. His interests, however, spread far beyond his immediate business. He served his own industry as president of the American Gear Manufacturers Association and also was a former director of the National Association of Manufacturers and of the National Metal Trades Association.

Aside from strictly industrial activities, Mr Markland was thoroughly alive to his responsibilities as a citizen. His civic mindedness led him into prominence in the affairs of Stone Harbor, N. J., where he served as mayor. Until his death, since 1935, he was president of the Philadelphia Board of Trade.

MEETINGS

American Society of Mechanical Engineers —*Fall Meeting, Louisville, Ky., October 12–15, 1941. Joint meeting ASME Fuels and AIME Coal Divisions, Lafayette College, Easton, Pa., October 30–31, 1941. C E Davies, secretary, 29 West 39th St, New York, N. Y.*

Technical Association of the Pulp and Power Industry — *Fall meeting, Ann Arbor, Mich., September 16–17, 1941. P G MacDonald, secretary 122 East 42nd St, New York, N. Y.*

A TREASURE CHEST

of useful information...

From time to time over a period of years our technical staff has unearthed new facts concerning metals. This wealth of information has been accumulated out of wide experience in the solution of problems involving the use of Nickel and its alloys.

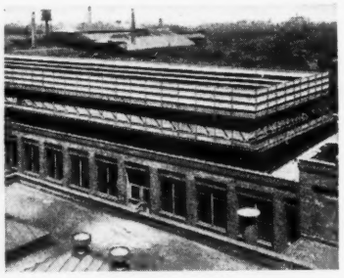
On the basis of this experience much helpful literature has been compiled. Dealing with the selection, fabrication and use of Nickel alloys it can be of great help to the metal working industries at a time like the present.

In addition to printed matter, we are glad to make available the assistance of our technical staff in solving problems arising from a temporary lack of Nickel. Your request for literature or personal consultation will receive our prompt attention.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

RECONDITION
Your COOLING SYSTEM with
SPRACO NOZZLES

With the ever-increasing national defense load and threatened water shortages, it is good insurance against power failures to bring your cooling system up to date. Replace worn, inefficient nozzles with new Spraco center-jet or ramp-bottom nozzles. The finely-divided sprays will give you maximum cooling at a minimum of expense. We carry in stock for immediate shipment several sizes of both types in cast iron and bronze.



Typical Roof Cooling System with Louvre Fence.

If plant expansion has encroached on your cooling pond, a complete cooling system can be installed on the roof of a building, with louvre fences to prevent spray drift.

Section of Typical Spraco Cooling System at Ground Level.

Spraco engineers are prepared to estimate the cost of revamping or increasing the capacity of existing equipment as well as designing complete new systems.

Write for Cooling Systems Bulletin.

SPRACO AIR WASHERS

Spraco Air Washers are designed primarily for washing and cooling the air for ventilating electrical machinery. We are prepared to furnish replacement parts for any existing Spraco Air Washer and shall be pleased to quote on eliminator plates, nozzles or accessories.

Write for Air Washer Bulletin

SPRAY ENGINEERING CO.

120 Central Street, Somerville, Mass.

How to Synchronize Two Power Systems

By JAMES WILSON

Purchase of outside power for use in an isolated plant always entails some interesting studies. Major problems encountered are: protection of the incoming feeder, proper metering of the load upon it, synchronizing of the plant to the feeder, and operation of the voltage regulator and prime movers in the isolated plant.

First check the voltage regulator. Find out from the regulator manufacturer what data they need to determine whether the regulator will function properly in parallel with the larger system. In general, the isolated plant voltage regulator will function properly if the distance is several miles from the other plant. If there is a transformer bank in between the stations that load interchange must pass through, regulator operation will be improved. There may be some special condition that will have to be handled as the manufacturer of the regulator directs, in addition to the recommendations that follow.

Feeder Panel

Even with minimum equipment, a panel for successful operation of the purchased-power feeder equipment is necessary. This panel will mount protection equipment, load-indicating and load-measuring devices and any desired relays. Load-indicating and measuring devices, and relays are modified if requirements allow load to be fed out at time to the power company.

Minimum equipment for the purchased-power panel calls for an oil circuit breaker with overload protection, watthour meters to measure power interchange, and synchronizing equipment.

The oil circuit breaker used on this panel should have an interrupting capacity of at least 25,000 kva to protect both the purchased-power feeder and the isolated-plant equipment. Consult the power company to see if a larger one is required, as the line may be able to feed in a large amount of power in case of a fault in the isolated plant. This breaker is also back-up protection in case of breaker failure in the isolated plant.

Overload protection for the purchased-power feeder should be better than that on the plant feeders. This will allow a faulty plant feeder to open without opening the purchased-power feeder. Should the plant feeders have instantaneous trips, an inverse-time

BALDWIN-HILL

B-H Heat Insulation Products

No. 1 Insulating Cement

A plastic material easily applied to large and small odd shaped equipment as well as flat surfaces. It is effective up to 1800° F. and 100% reclaimable when used on equipment up to 1200° F. It has exceptionally high coverage, low volume shrinkage and high adhesiveness. Packed in 50 lb. bags it presents no storage or breakage problems.

To insure better temperature control, high insulating efficiency, low heat losses and to prevent waste of power—look to B-H Insulations.

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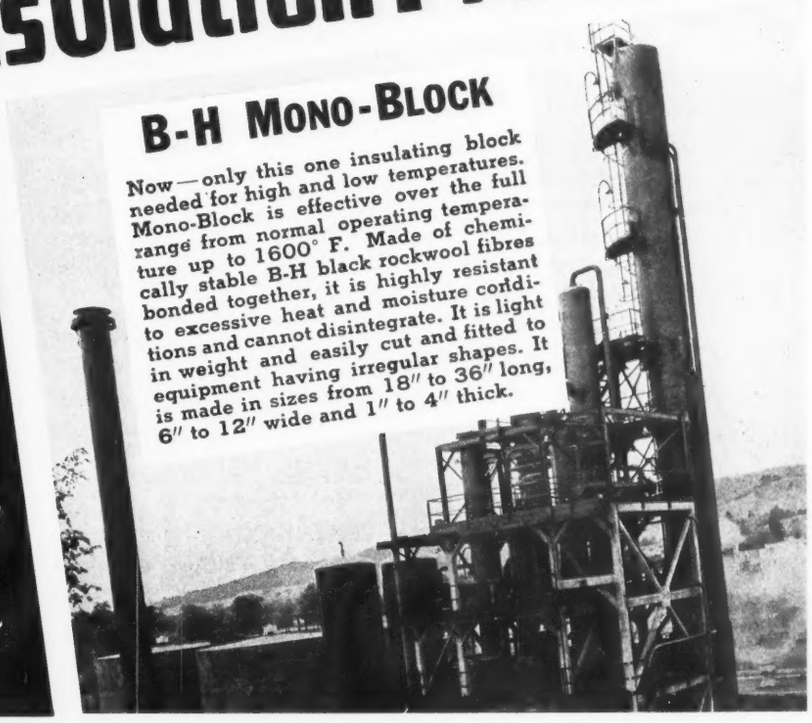
B-H MONO-BLOCK
B-H Rockwool BLANKET
B-H No. 100 PIPE COVERING
B-H No. 1 INSULATING CEMENT
B-H FELT INSULATION
B-H WEATHERSEAL

and other insulating materials effective up to 2000° F.

Send for Catalog

B-H Mono-Block

Now—only this one insulating block needed for high and low temperatures. Mono-Block is effective over the full range from normal operating temperature up to 1600° F. Made of chemically stable B-H black rockwool fibres bonded together, it is highly resistant to excessive heat and moisture conditions and cannot disintegrate. It is light in weight and easily cut and fitted to equipment having irregular shapes. It is made in sizes from 18″ to 36″ long, 6″ to 12″ wide and 1″ to 4″ thick.



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*Buell Equipment Saved One Company**

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The case cited above is just one example of savings made possible by Buell (van Tongeren) Dust Collectors. The high efficiency of the van Tongeren system of dust collection, offered only in Buell equipment, is evidenced by orders *and re-orders* from an impressive list of America's industrial leaders, firms such as—

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Low first cost and negligible operating and maintenance expense are other Buell advantages that will interest you.

** Name on Request*

You will find valuable dust control information in *"Bulletin P-9, Dust in Industry"*. A copy will be sent on request.

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Nation-wide service through offices of either Buell Engineering Co. or B. F. Sturtevant Co.

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DUST COLLECTORS

limit should be used for the purchased-power feeder. If this is applied, some type of alternating-current trip with an induction-type relay should be provided. Consult the power company for the proper overload setting so that the purchased-power feeder will not be opened at its source.

The question of power flow for the purchased-power feeder determines the type of load-measuring and metering devices. In any case, these devices should be similar to those on the generators. The wattmeter and watthourmeter will be the same as on the generator, (except possibly scale differences), unless it is intended to feed out at times on the purchased-power feeder. In that case a zero-center wattmeter and two watthour meters with ratchets are required. Contract requirements may also require a block-type graphic watthourmeter and reactive meter.

Alarm System

Some type of alarm system may be required to signal when purchased-power feeder load gets too high or too low, or it may even be used to actuate a governor-control system.

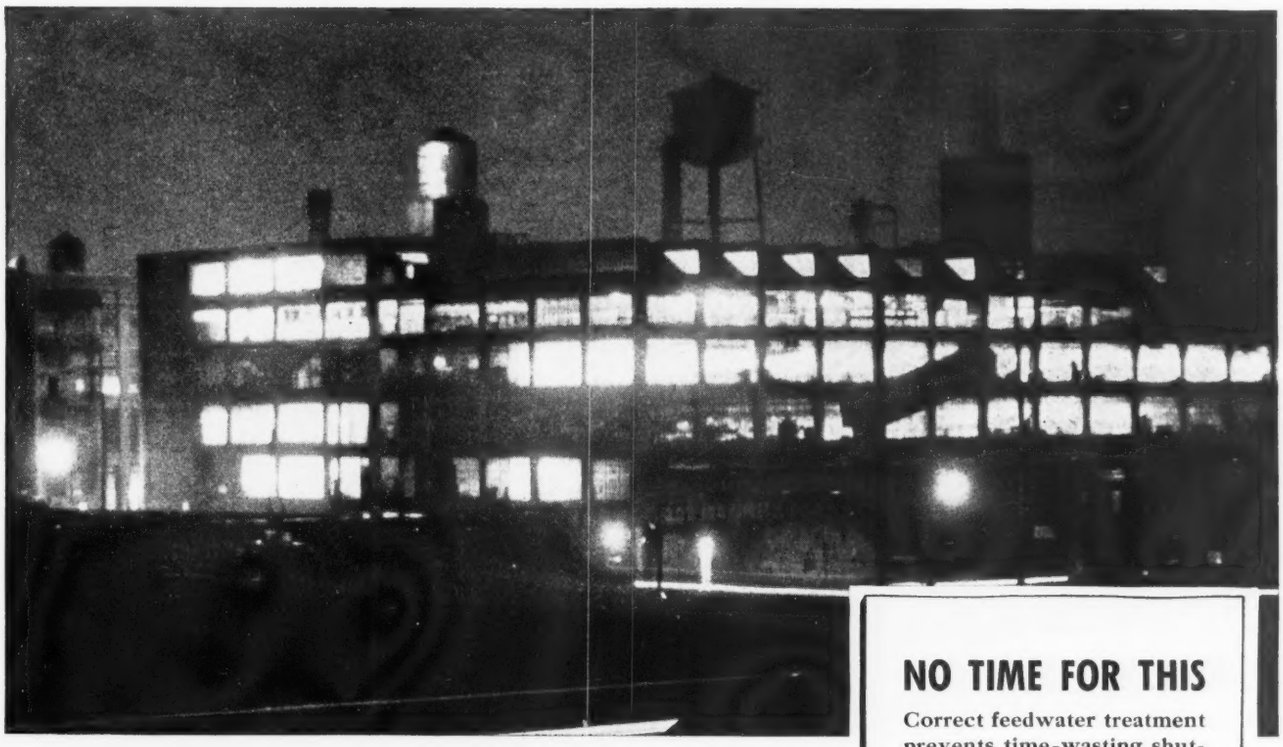
For the purchased-power feeder, potential transformers should have the same ratio as those now used. Select the ratio of the current transformers so that normal full-load current on the feeder will be about two-thirds of their ratio. This will give the best indications on wattmeters and ammeters and accuracy on the watthour meter.

Connections are not a difficult problem. Overload devices are connected as on the plant feeder if of the same type, otherwise as shown on the diagrams furnished with them. The ammeter, wattmeter, and watthour meter are connected as on the generator. If power is to flow either way on the purchased-power feeder and be metered for both ways, connect the "in" watthour meter the same as on the generator, and the "out" watthour meter with either the current or potential connections reversed. Relays for alarms, etc, are connected according to the diagram furnished by the manufacturer.

Synchronizing

There are two types of synchronizing. One uses "start" and "run" plugs, the other but one plug. If the 2-plug system is used, synchronizing connections for the purchased-power feeder are exactly as on the generator. If a single-plug system is used, the synchronizing receptacle is wired so that the bus potential transformer is connected to the "start" winding of the synchroscope, and the purchased-power-feeder poten-

For "all-out" production—your boilers MUST stay in service!



Prevent scale—and shutdowns—with PERMUTIT* conditioned feedwater

Even under ordinary conditions it is important that feedwater treatment exactly fits your own plant requirements. Under the strain of continuous defense production, it is imperative!

During this period of "stepped-up" power-loads, thousands of steam plants are relying upon "Water Conditioning Headquarters" to give them complete protection against boiler scale and corrosion. Permutit provides every process for conditioning feedwater . . . Permutit installations are treating every variety of raw water, every feedwater volume up to millions of gallons daily.

Why not let Permutit work with your engineers to insure top efficiency at your plant? Write us about your problem or ask for free booklets: The Permutit Company, Dept. A, 330 West 42nd Street, New York, N. Y.

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NO TIME FOR THIS

Correct feedwater treatment prevents time-wasting shutdowns to clean boilers, repair or replace choked up superheaters and feed lines.

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Thrifty Macwhyte Cables win favor in Thrift-minded Milwaukee!

Milwaukee, Wisconsin. "Famous" for its wide variety of products, its progressive government, and its thrift-minded citizens is this great mid-west city.

And in many of its fine buildings are found an elevator cable that's "famous," too... Macwhyte Special Traction, which has won the approval of many Milwaukeeans for its thrifty service, its low-cost-per-car-mile.

PREformed for PLUS Performance

And now for those who want a cable that provides even *greater* smoothness in operation, and extra thriftiness, there's Macwhyte "Hi-Speed" Special Traction. This special 8 x 19 cable is made with large outside wires for more surface wear. And *most important* "Hi-Speed" is PREformed . . . that's why it has greater fatigue resistance, much greater flexibility, and maintains its balance as each strand carries an equal load.

For real low-cost-per-car-mile, try a set of Macwhyte "Hi-Speed" Special Traction Cables . . . PREformed for better performance and thoroughly lubricated to provide continuous protection against corrosion and friction.

MACWHYTE COMPANY, 2944 Fourteenth Avenue Kenosha, Wisconsin • *Manufacturers of wire rope to meet every need — left-&-right lay braided slings — Stainless Steel wire rope — Aircraft cable, Aircraft tie-rods, and "Safe-Lock" Swaged Terminals.*

Hi Speed

MACWHYTE SPECIAL TRACTION

PRE-FORMED FOR Elevator Cable *BEST PERFORMANCE*

CRANE ROPES

Put MONARCH WHYTE STRAND PREformed CRANE ROPES to work—for safety and economy. Ask for details.

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SLINGS

Try this new technique of heavy lifting. Your loads will be handled safely and easily. Send for literature on ATLAS Braided Wire Rope Slings.

MACWHYTE Atlas BRAIDED WIRE ROPE Slings

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tial transformer is connected to the "run" winding of the synchroscope. Be careful to use the same phase of the potential transformers as used on the generators for synchronizing.

Before synchronizing the plant to the purchased-power feeder for the first time, a test for correct phase rotation on the feeder *must* be made. This can probably be done best at the time the plant is shut down to connect the purchased-power feeder to the plant bus. This test is made by selecting any 3-phase motor that can be easily disconnected from its load or where a reversal of rotation will do no damage.

Check Voltage

Temporarily connect the purchased-power feeder and close the oil circuit breaker to energize the station bus. Check the voltage to see that it is correct on all three phases. The voltmeter is connected the same as on the generator. The motor selected for the rotation test is then started. If rotation is the same as usual, connections of the purchased-power feeder can be made permanent. If motor rotation is reversed, then any two of the phases on the feeder side of the purchased-power-feeder oil circuit breaker must be interchanged and rotation checked again. When the motor rotation is found to be correct, connections are then made up permanently.

If speed is necessary, the engines can be put back on the bus and the load carried as usual while the purchased-power-feeder breaker is open and the connections are being made up.

When the bus is alive from the purchased-power feeder, a generator is synchronized exactly as before if the 1-plug system is used. If the two-plug system is used, put the "run" plug in the feeder receptacle, or in a generator already on the bus, and the "start" plug in the generator receptacle and handle as before.

If the bus is alive from the generators and it is needed to synchronize the bus to the purchased-power feeder, put the synchronizing plug in the feeder receptacle (1-plug system). The operations are then similar to handling a single generator except that all generators running have to be controlled to get correct speed and voltage and at the same time keep correct load division. When synchronism is reached close the feeder breaker.

If the 2-plug system is used, the "run" plug is used in the feeder receptacle and the "start" plug in any running-generator receptacle. The operation then is the same as if a single plug were used.

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That's why we haven't had much use for the word "No"—up to the time of priorities and preference ratings. But Uncle Sam has the final word in this emergency, and now we sometimes find ourselves unable to oblige even our oldest and best friends.

Revere Technical Advisory Service will, however, continue to work closely with you, bringing to bear on your problems all of Revere's extensive knowledge of materials. In some cases we have been able to guide our customers into Defense contracts in which priorities work for them instead of tying their hands. So get in touch with Revere—together we may find a way of changing "No" to "Yes".

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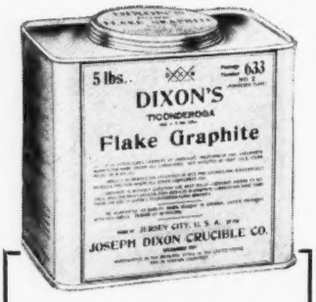
LUBRICANT

Retains its lubricity . . .
Remains unchanged in highest operating temperatures . . .
Unaffected by pressure . . . solvents . . . moisture . . .

Dixon's Ticonderoga Flake Lubricating Graphite lubricates long after plain lubricants break down or squeeze out.

Alone or mixed with oils and greases, graphite impregnates wearing surfaces with a thin, durable lubricating film that prevents costly damage.



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Particle Size No. 1—large, lubricious flakes.
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Minutely subdivided particle size for close tolerance applications.

DIXON'S MICROFYNE POWDERED GRAPHITE

Microscopically subdivided particle size for mixing with oils and greases. Also for dry lubrication of locks, small tools, etc., through handy Dixon's Graph-Air Guns. Can't drip, gum, or collect dust.

A DIXON man can tell you—quickly and surely—WHERE and HOW Dixon Graphites can cut lubrication costs in YOUR PLANT. Write Dept. No. C-94.

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Saves time and labor in proper maintenance of leather, rubber and composition belts. Reduces belt slip, lengthens belt life. No need to shut down for application. Contains no graphite.

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JOSEPH DIXON CRUCIBLE CO.
Jersey City, New Jersey

647

After synchronizing the plant to the purchased-power feeder, the voltage regulator may need some adjusting so that the plant does not try to carry the total system wattless load. The manual supplied by the manufacturer will tell how to do this. Wattless-load division between generators in the plant is handled as before.

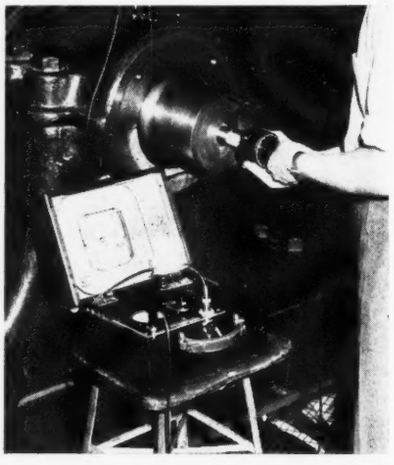
Governors on the plant engines will quite likely need a careful overhaul and adjustment to work well with the quite steady frequency of the modern utility.

The engineer will have to watch station load much more closely than before to keep the purchased-power feeder load within contract requirements. A relay system as noted before will be very helpful for this, for sometimes the engineer may be very busy and let load on the purchased-power feeder get into the penalty range.

New Plant Equipment

Balancing Machine

PORTABLE DYNAMIC BALANCING MACHINE consists of three principal parts: sine-wave alternator, vibration-velocity unit, and indicating unit and its associated circuits, all in handy carrying case. It can be used



during initial rotor manufacture, after subsequent servicing, or to correct unbalance caused by pitting or corrosion. Rotors may be checked with device while they are running in original or substitute bearings. *General Electric Co, Schenectady, N. Y.*

Reducing Valve

RELAY-OPERATED Copes pressure-reducing valve designed for remote-control service with water or steam. Actuating element is reinforced-rubber diaphragm with mean effective area of 41 sq in. Relay-operating cylinder of control valve has mean effective

FOR STEAM, WATER, OIL

Here's a globe and angle valve stem packing that's equally effective against high-pressure steam, hot or cold water, or oil. It gives superior service because it's made with long fibre asbestos yarn and is lubricated with a special Garlock compound which resists heat. Try GARLOCK 117 on your valves!

Garlock 117 Packing is furnished either braided or twisted. Made in standard sizes from $\frac{1}{16}$" to $\frac{3}{4}$", advancing by sixteenths. Packaged on 1-pound, 2-pound and 5-pound spools.

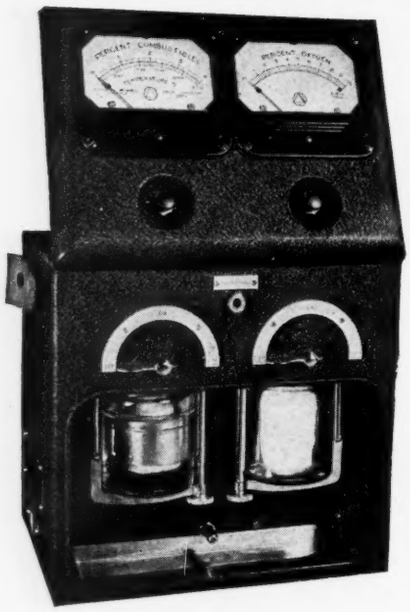
THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Co. of Canada Ltd., Montreal, Que.

garlock 117

VALVE STEM PACKING

Users of CITIES SERVICE LUBRICANTS get an EXTRA ADVANTAGE with HEAT-PROVER SERVICE



Heat-Prover Service is now available to users of Cities Service Industrial Fuels and Lubricants. This is an economy measuring service which you can secure in addition to the quality and economy advantages offered by Cities Service's SERVICE PROVED Fuel and Diesel Oils.

The Heat-Prover is an ingenious device—a by-product of our research in metallurgy. It registers continuously and instantaneously changes in the amount of oxygen and combustibles in furnace gases. It is an excellent guide in adjusting 4-cycle Diesels and for combustion control in heat generating plants. In the heat treatment of metals, it is invaluable. It assures uniformity and reduces scrap losses.

Let us tell you how you can secure the use of one of these machines. Mail the coupon today for further information.

CITIES SERVICE DIESEL LUBRICANTS

FREE—Just clip and mail

CITIES SERVICE OIL COMPANY
Room 1326, Sixty Wall Tower, New York

Please tell me how I can get Heat-Prover Service in my shop. PR.

Name .....

Name of Shop .....

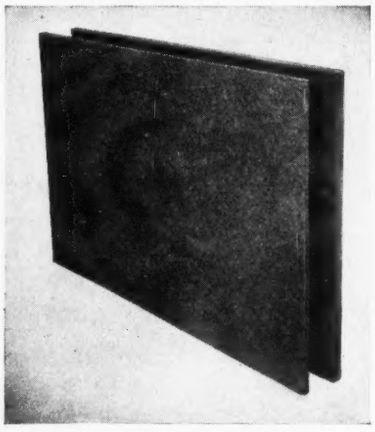
Address .....

City ..... State .....

area of 28 sq in. Water, air or oil at from 50 to 100 lb constant pressure can be used as operating medium. One side of diaphragm is open to atmosphere, while other is subjected to operating pressure from pilot of Copes master control. Any pressure change from master control pilot causes diaphragm to move. This movement is transmitted through an adjustable shaft extension and floating lever to pilot valve of relay operator. This changes pressure on one side of operating cylinder, moving valve in opposite direction until pilot is reset by floating lever, one end of which is attached to reducing-valve stem. *Northern Equipment Co, Erie, Pa.*

Insulation

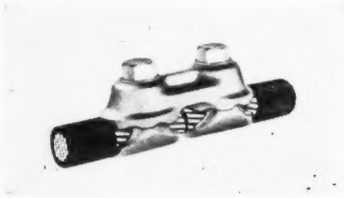
"KOLDBOARD" recently added to line of rockwool insulation made by company. Consists of insulating block with mineral base, for low-temperature work. Reports from laboratory show that its moisture absorption is only 0.68% at a relative humidity of 65% at a temperature of 75 F. Maker says, due to its composition and physical properties, material will not dis-



integrate, suffer structural breakdown or decay. *Baldwin-Hill Co, 575 Klagg Ave, Trenton, N. J.*

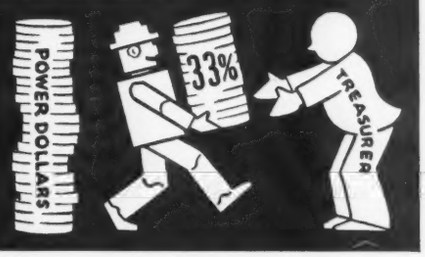
Connector

TYPE ER CONNECTOR, illustrated, is used to join copper-cable conductors on end, parallel to each other or at an angle. Can also be used as coupler or reducer. Swivel principle of Versi-link permits cables to be



inserted into either eye from seven different angles and clamped rigidly in one position. Each cable-clamping element will accommodate large range of conductors without any extending parts or exposed threads. *Burndy Engrg Co, 459 East 133rd St, New York, N. Y.*

Traylor's IRON FIREMAN Earns 33% a Year



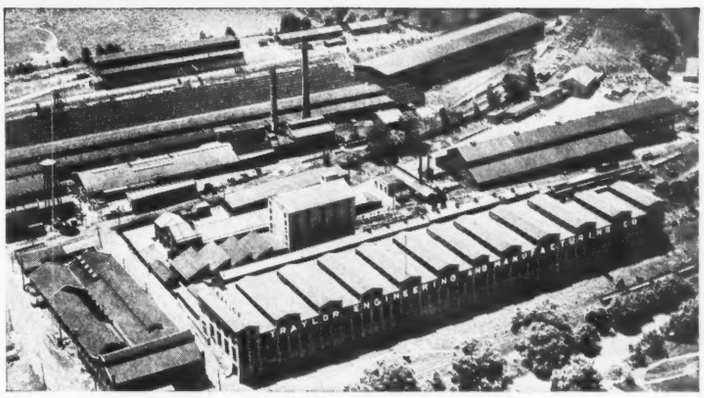
AN Iron Fireman Pneumatic Spreader Stoker *saves every year, ⅓ the cost of the installation*—for the Traylor Engineering & Manufacturing Co., Allentown, Pa. The Traylor Co., nationally-known manufacturer of heavy milling and mining machinery, is using only one boiler where it formerly required two. Cost of ¾″ slack now burned is $1.04 less a ton than the coal formerly required with hand-firing.

Higher Boiler Efficiency Achieved Despite 30-Year-Old Boiler Setting

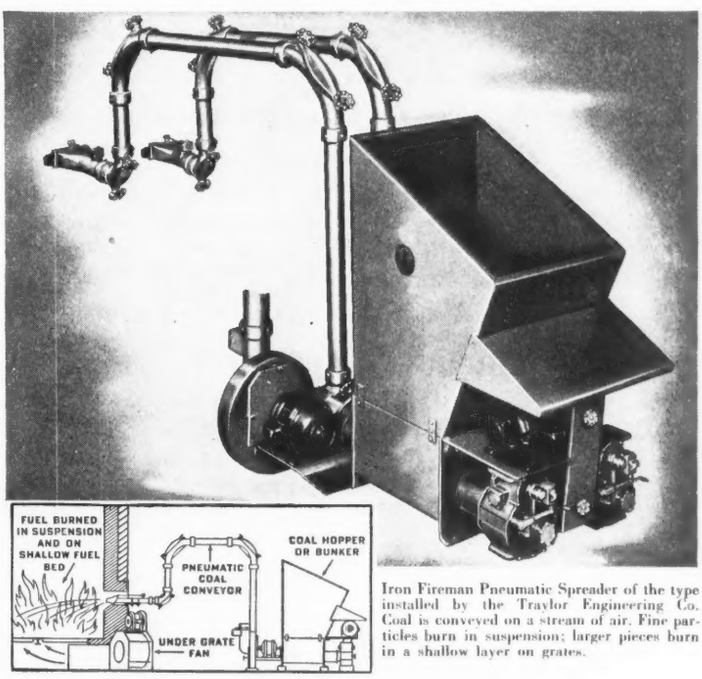
Although not equipped with economizers or preheaters, Traylor's 214 h.p. boiler in a recent test showed 73.7% efficiency, developing an average rating of 140.5%. Iron Fireman's savings record covers a period of nearly three years.

ENGINEERS . . . We will Help You Compute YOUR Potential Savings

You may be able to develop more power from your present boilers—and save money doing it. Let an Iron Fireman Engineering Survey help you determine your possible savings and power increases. This thorough, scientific survey will be made in cooperation with plant or consulting engineers. Mail the coupon below. There is no obligation.



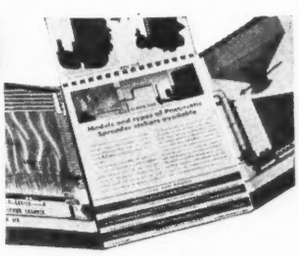
Airplane view of the plant of the Traylor Engineering Co., Allentown, Pa., where an Iron Fireman Pneumatic Spreader has taken over the firing, cutting steam costs and increasing efficiency.



Iron Fireman Pneumatic Spreader of the type installed by the Traylor Engineering Co. Coal is conveyed on a stream of air. Fine particles burn in suspension; larger pieces burn in a shallow layer on grates.

IRON FIREMAN

Automatic Coal Stokers



SEND FOR FREE NEW PORTFOLIO

Mail coupon, without obligation, for free copy of new Iron Fireman Pneumatic Spreader portfolio. Simple diagrams of stokers, blueprints and operating data of typical installations.

IRON FIREMAN MFG. CO. (Portland, Ore., Cleveland, Toronto.)

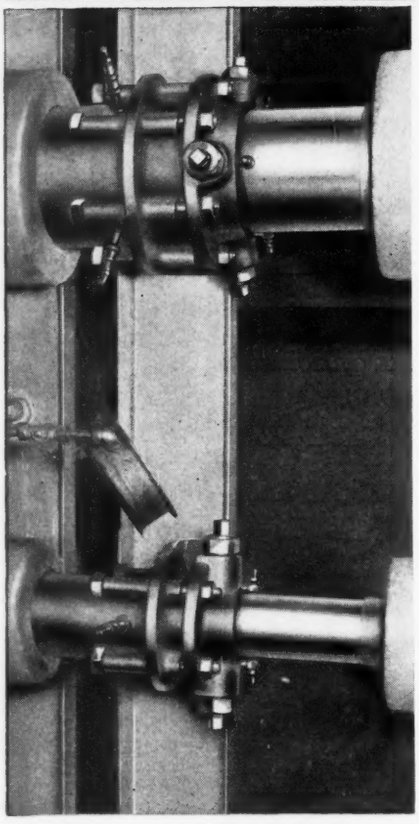
Mail to 3013 West 106th St., Cleveland, Ohio.

☐ Send, Free, new Pneumatic Spreader Portfolio.
☐ See us about making, without obligation, an Iron Fireman Engineering Survey.

*Name*_____

*Address*_____

YARWAY
GUN-PAKT EXPANSION JOINTS



Big Automobile Company Uses 67 Yarway Joints

First purchased 3 years ago. Reordered 7 times to present total of 67 Yarway Gun-Pakt Joints, ranging in size from 3 in. to 14 in.

Why don't you select the Expansion Joint that is packed under full steam pressure. A twist of a wrench forces a special semi-plastic packing into the stuffing box by means of integral pressure guns. No need to remove old packing. New packing rejuvenates the old. No need to shut off steam. Write for Catalog EJ-1907.

YARNALL-WARING CO.
100 Mermaid Ave., Phila., Pa.

Multi-Breaker

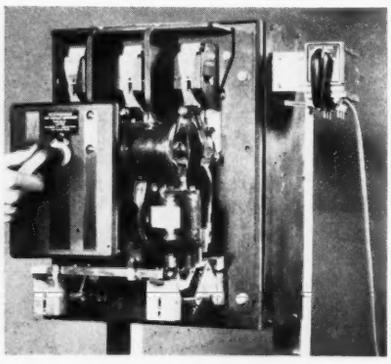
INDUSTRIAL 230-volt Multi-Breaker can be applied as motor circuit switch or service disconnect switch. Unit is fuseless, with bi-metallic strip actuation, visible trip indication and trip-free lever. Rated at 230 volts, from 15 to 100 amp, available in 3-pole, 3-pole solid neutral and 4-pole solid neutral types. *Cutler-Hammer, Inc, Milwaukee, Wis.*

Insulators

VIBRO-INSULATORS, mountings of rubber and metal to isolate vibration, now announced in three additional models. Type 44 is for use with gas burners, Type 50 specially engineered to isolate internal-combustion engines against torsional vibration, and Type 60 for isolating vibration and noise of exhaust and intake fans. First type furnished with rubber either in shear or compression. In shear, maximum loading is 10 lb, deflection at that load $\frac{5}{32}$ in. and minimum disturbing frequency at that deflection 1200 per minute. In compression, maximum load is 50 lb, deflection at this figure $\frac{1}{8}$ in. and minimum disturbing frequency 1350 per minute. Type 50 compression construction will take care of minimum disturbing frequencies from 1200 per minute and up and is made in 35, 40, 50, and 60 durometer hardnesses. Type 60 is compression mounting used where lowest disturbing frequency is 100 per minute with a maximum recommended load of 240 lb. *B F Goodrich Co, Akron, Ohio.*

Transformer

INDOOR-CURRENT TRANSFORMERS have practically flat ratio and phase angle curves from 15 to 200% current, resulting in high metering accuracy over wide load range. Unaffected by unbalanced loads, performance is same under zero or maximum unbalance in 3-wire circuit. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*



Tachometer

MEASURES revolutions per minute, feet per hour, gallons per minute. Consists of alternating-current generator and voltmeter of rectifier type. Rotating element consists of laminated iron keyed to rust-resisting steel

Clean Porcelain Insulators This SAFE, Easy Way!

How do you clean your porcelain insulators? By tedious, time-consuming manual methods? Want to do this work easier and faster . . . make worthwhile savings in time and money?

Then use the speedy, low-cost Oakite method. A 60-second dip in solution of recommended Oakite material, followed by wiping or light brushing, removes weather film, dust, grit and grime.

Insulators are again clean, looking practically like new. .with normal insulating efficiency restored. Beyond its economy, this method is absolutely SAFE...has no harmful effect on finished surface of insulators in the least!

DETAILS FOR THE ASKING!

It will pay you to get more data. Also ask for FREE booklets and data sheets packed with helpful, money-saving tips on such other maintenance jobs as cleaning heat exchangers, stripping transformers, cleaning air filters, safely descaling water-cooled equipment. Write today!

OAKITE PRODUCTS, INC.
23 Thames Street, New York, N. Y.
Representatives in All Principal Cities of the United States and Canada.

OAKITE *Certified cleaning*
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

TOLERANCE

We know only too well how much you need steel. We are doing everything humanly possible to get it for you. Every man in this company is doing his utmost to produce every possible pound of material.

Because of the seriousness of this nation's emergency, defense must come first. We are cooperating with the Government to the limit as you would want us. At the same time we are keenly aware of the needs of our customers, and we are doing our best to serve you, too.

Tolerance is one of the virtues that will help tremendously in this hour of our country's need.

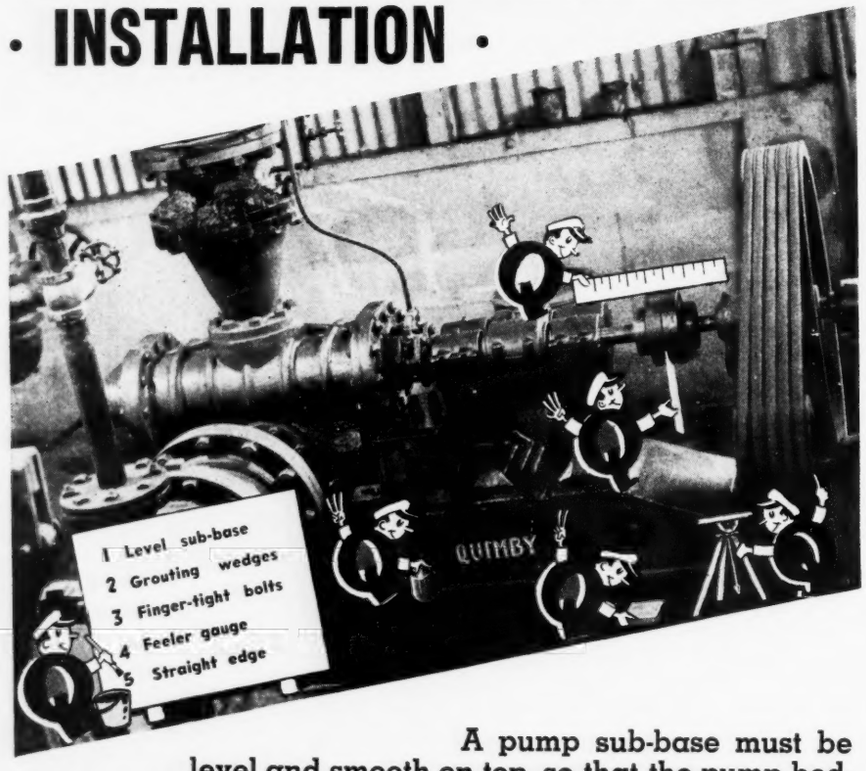
THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

Q 2 PUMPING CUES TO BETTER PUMPING PRACTICE

OF A SERIES

• INSTALLATION •



A pump sub-base must be level and smooth on top, so that the pump bedplate, which is planed on the bottom, will bear at all points. No holding-down bolts or grouting are necessary. If, however, you wish to grout the pump, be sure that the bedplate is level and that the weight is carried evenly on wedges, so that the grout can flow under the edges of the base. Also, see that the pump turns over without binding before pouring the grout. When holding-down bolts are used, the nuts should be only finger-tight and not tightened with a wrench. This will prevent warping the bedplate, causing binding and unnecessary wear.

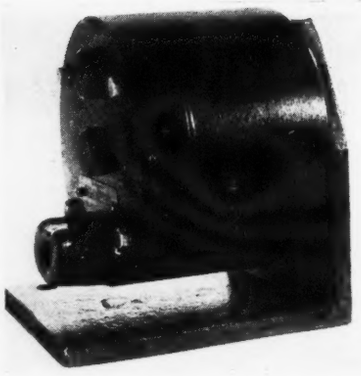
Alignment should be checked in two ways, both during and after erection: (1) with a feeler gauge, on those types of couplings where this is possible, inserted between the two halves to make sure they are parallel, and, (2) with a straight edge against the circumference of the two halves to make sure that they match on centers.

CONCERNING DELIVERY: National Defense priority may cause even our oldest customers some delay in delivery. We earnestly request your patient cooperation until our present expansion program can relieve this situation.

QUIMBY PUMP CO.
INC.
347 THOMAS STREET
NEWARK, N. J.

QUIMBY SCREW PUMPS

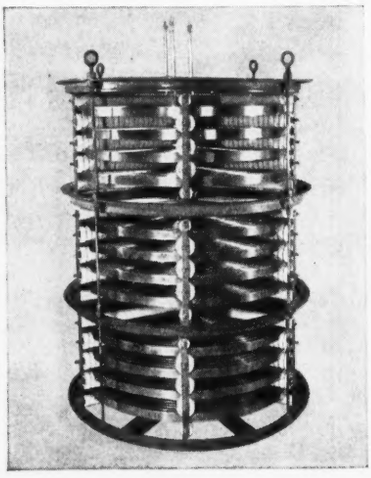
. . . GOOD PUMPING PRACTICE SINCE 1894 . . .



shaft. Laminations are slotted to permit variation of air gap reluctance when shaft is rotated. This in turn varies flux linking the voltage coils and induces an alternating voltage in coils. Alternating voltage is rectified by a Rectox unit in voltmeter calibrated in rpm, etc, depending upon application. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

Heaters

FALCON LINE OF ELECTRIC immersion-type heaters used for maintaining and increasing temperatures of wide range of materials. Consist of spirally coiled heater strips arranged to form compact unit, installed in sealed tank built in pipe line between



storage vessel and coating or saturating tank. Temperature is maintained uniformly by means of automatic controls, either thermostat or pyrometer with thermocouple. *H O Swoboda, Inc, 185 13th St, New Brighton, Pa.*

Pumps

TYPES A AND T HORIZONTAL PUMPS are available in all sizes from ¾ to 6 in. in capacities up to 1400 gpm, for operating heads to 100 ft. Different material used in pump construction, choice dependent upon extent of abrasion or corrosion under which pump will operate. Type A shown, while Type T similar in design except that intake opening is horizontal and concentric with shaft. Pumps are recommended for handling sludge, slime and slurries. *Amer-*

1941 Ended in April for boilers operating on a 3-shift day

Keep them on the line . . . with fewer shutdowns for cleaning and repairs . . . by APEXIOR-coating the tubes and drums today!

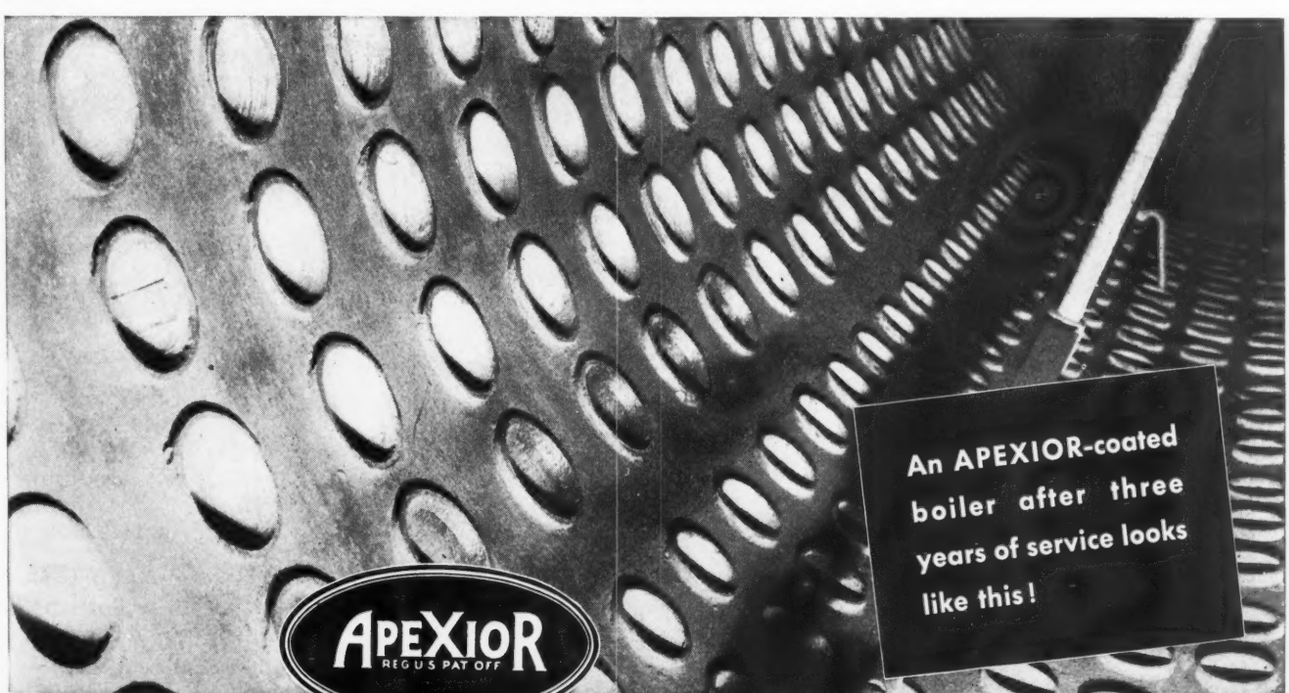
If your plant has jumped from one to two or three shifts in order to step up production, your boilers are operating at a rate that will necessitate shutdowns two or three times oftener!

But an APEXIOR coating will push back the day they must come off the line. APEXIOR, brush-applied to new boilers or old boilers after cleaning, prevents or checks corrosion for up to 3 years without renewal. It also prevents the tight adherence of scale — makes cleaning easier and infrequently required.

All U. S. and Canadian boiler insurance companies recommend APEXIOR. Many plants use APEXIOR to supplement their water treatment, so as to get *utmost* protection.

The time it takes to apply APEXIOR can be reduced almost to the negligible point by use of the recently developed Tube Coating Machine, which also insures a good quality of coverage.

Start now on a standard of boiler maintenance which means uninterrupted service for much longer periods of time. Write now for Bulletin 1290.



THE DAMPNEY COMPANY OF AMERICA

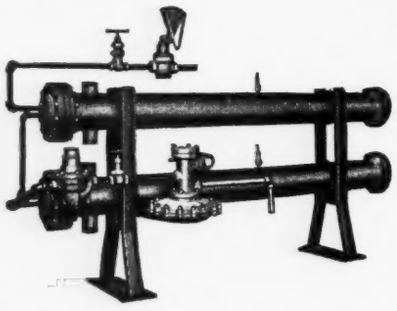
PROTECTIVE COATINGS FOR STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

HYDE PARK · BOSTON · MASSACHUSETTS

Atlanta — Chicago — New York — Detroit — Philadelphia

Engineering Sales Representatives — Pittsburgh, Cincinnati, New Orleans, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B. C., Montreal, P. Q., Havana, Cuba, Manila, P. I., Honolulu, T. H., Marine Dept., 114 Liberty Street, New York, N. Y.

LESS MAN-POWER
MORE HORSE-POWER



HENSZEY

CONTINUOUS BLOWDOWN

will increase boiler capacity and at the same time release man-power for production work.

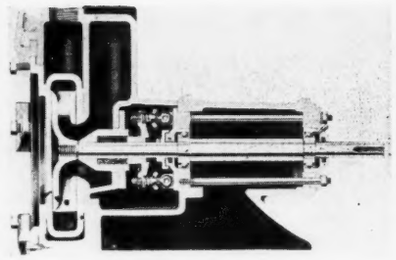
The Henszey system is continuous, automatic and operates without heat loss. Boiler water concentration is kept at a predetermined proper degree, insuring CLEAN BOILERS, CLEAN WATER, and CLEAN STEAM. Which means:

1. CONTINUED OPERATION—boiler can efficiently produce maximum output for longer periods of time. Scale, priming, foaming, and carryover are eliminated.
2. LESS MAINTENANCE—no unnecessary man-hours lost keeping boilers clean, replacing tube burns, replacing packings, repairing or replacing rods and cylinder rings, turbine nozzles, turbine blades, reducing valves, non-return valves, or other troubles.
3. LOWER POWER COSTS—lower cost per h.p. means fuel savings—always important but *vitally* important in some sections of the country right now.

Send for bulletin

HENSZEY COMPANY
Dept. D9 Watertown, Wis.

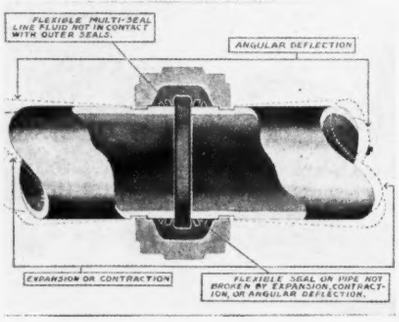
HENSZEY
POWER PLANT SPECIALTIES



ican Manganese Steel Div, American Brake Shoe & Foundry Co, Chicago Heights, Ill.

Pipe Coupling

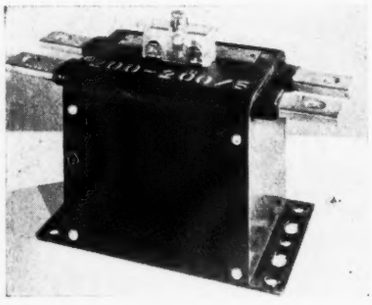
DILLON PIPE COUPLING consists of housing, see illustration, made in two parts bolted together, and a rubber multi-seal ring that fits over pipe ends and is held in place by housing. With multi-seal rubber ring there are three points of contact on each side of pipe joint and because of this construction, says maker, it is impossible for fluid or gas to leak past seals. This form of joint


FLEXIBLE MULTI-SEAL LINE FLUID NOT IN CONTACT WITH OUTER SEALS.
ANGULAR DEFLECTION
EXPANSION OR CONTRACTION
FLEXIBLE SEAL OR PIPE NOT BROKEN BY EXPANSION, CONTRACTION, OR ANGULAR DEFLECTION.

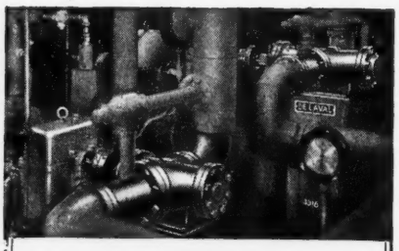
will permit normal contraction or expansion of pipe line and also of angular deflection in the line at joints of a little over 5 deg from straight line. *Dillon Co, 220-C East Brady St, Tulsa, Okla.*

Circuit Breaker

TYPE DK BREAKER is available and designed for industrial, central station or power plants where operation under repetitive duty cycles is required. New breakers are equipped with rotary-type, removable op-



erating handle for controlling breaker manually. In addition, electric operation can be provided by motor mechanism and shunt trip. Main contacts are of silver alloy and employ self-wiping action. "De-ion" arc quenchers minimize burning on main and arcing contacts. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*



ABSENCE OF PULSATION
IMPROVES COMBUSTION

The De Laval-IMO pump favors better combustion by delivering oil to burners uniformly. Its action is like that of a continuously acting piston. There are no valves and no reciprocating parts, nor do the rotors trap oil. The moving members 3, are in perfect rotational balance.

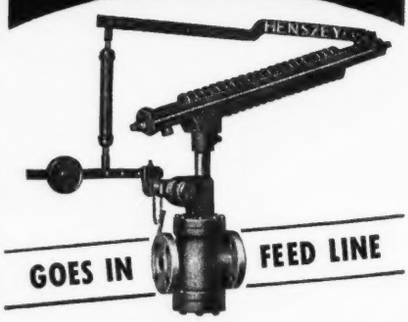
The two geared turbine driven IMO pumps here shown each supplies 90 g.p.m. of Bunker C against 250 lb. pressure to burners on 24-hour service in a central station.

De Laval-IMO pumps are available in all sizes and for all pressures and to handle any grade of oil, from light Diesel to heavy Bunker C.

Ask for Publication 1-65.

IMO PUMP DIVISION
of the
De Laval Steam Turbine Co.
Trenton, N. J.

HENSZEY
BOILER FEED
REGULATORS



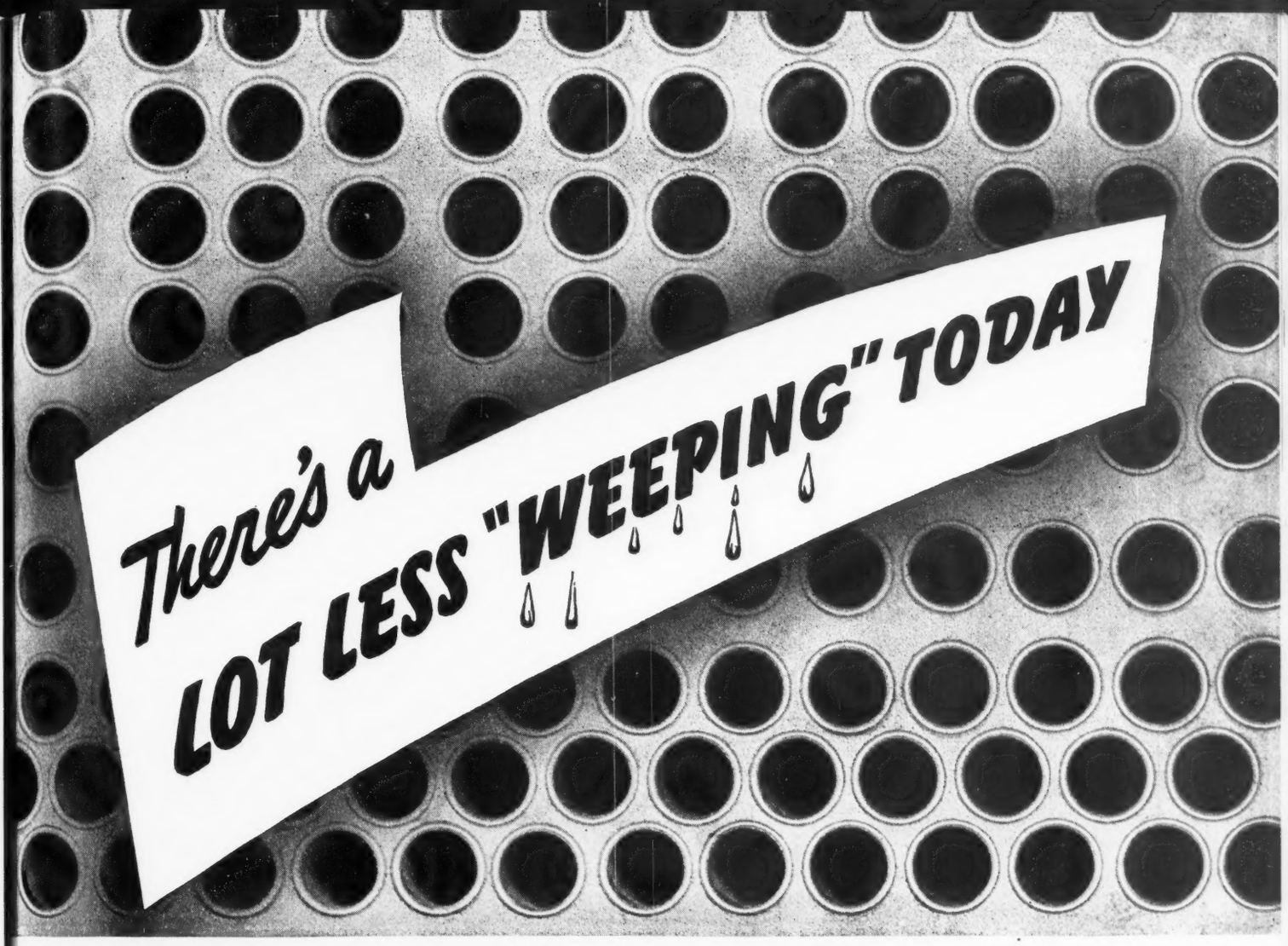
GOES IN FEED LINE

The Henszey Boiler Feed Regulator controls boiler water levels continuously and accurately under *all* load conditions!

These simple, compact, self-contained units go right in the feed line and require no additional structural support. They are as easy to install as a simple gate or globe valve. Once installed and set for operation no further attention is necessary — nothing to get out of order — nothing to reset.

Send for latest Bulletin containing full details.

HENSZEY COMPANY
Dept. D9—Watertown, Wis.



ELECTRUNITE boiler tubes are making tight joints–reducing "weepers"–saving re-rolling time!

In slides the last tube on the job. You expand it. You bead it over. Then you put the boiler under hydrostatic test. How many leaking joints or "weepers" will you have to re-roll?

If you used Republic ELECTRUNITE Boiler Tubes, the chances are in your favor that you will waste little time in re-rolling joints to tight, non-leaking fits. A good example of what you can expect is given in the report on a 300,000 lbs. per hour steam generating unit tubed with ELECTRUNITE. When 3,500 tube ends were tested at 1,365 lbs. pressure, not a single leak developed—and there were only 21 "weepers."

Republic ELECTRUNITE Tubes roller expand and bead to tight joints *EASILY AND QUICKLY*—because they're consistently uniform in diameter, wall thickness and concentricity—and because they possess the uniform ductility afforded by continuous process full annealing. They expand evenly all around the wall—without need for changing tools. By making tight joints on first rolling, they cut the time and cost of re-rolling. Steel and Tubes Division, Republic Steel Corporation, Cleveland, Ohio.

REPUBLIC STEEL
DEFENSE FOR AMERICA

Republic ELECTRUNITE

REG. U. S. PAT. OFF.

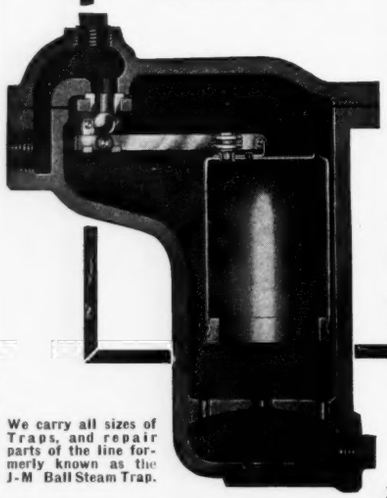
Electric Resistance Welded Boiler, Condenser and Heat Exchanger Tubes

RID YOUR STEAM LINES . . .
of trouble from ineffective traps

INSTALL THE "CRYER"

Operation of the CRYER STEAM TRAP on the inverted bucket principle, together with other outstanding features of design results in trap performance which *guarantees* the elimination of air-binding, slow venting and dribbling. Put a "CRYER" where you're having the most trouble and you'll put it on all your lines. It will cure your troubles and save you money because:

Made in sizes from ½" to 2½" inlet and outlet; capacities from 503 to 38,000 lb. of water from 1 to 250 lb.



It won't bind—all air is discharged before condensate through valve at top.
It's Positive Acting—correct seating is insured by free turning ball valve.
It's Quick Venting—air is discharged rapidly without regard to temperature through a mechanically controlled quick venting valve.
It's Accessible—all mechanism can be removed without disconnecting piping.
It has Large Capacity—sudden surges are prevented by baffle plate from lifting bucket and closing valve—action is fast because of quick venting.
It is low in maintenance—wearing parts are of stainless steel—free-turning ball valve minimizes wear—valve seat is easily removed—cleaning is simple and easy.

***Pays for* ITSELF**

Steam savings and greater efficiency in steam distribution result in economies which quickly repay installation cost. Write for complete information.

• • •

Manufacturers of Steam Specialties for more than 40 years.

We carry all sizes of Traps, and repair parts of the line formerly known as the J-M Ball Steam Trap.

CRYER
TRAP & VALVE CO., INC.
366 Madison Ave. New York, N. Y.

MASED LUBRICANT No. 177
for Bearing LUBRICATION in the HOTTEST Service Spots!

Economical, dependable maintenance of ball and roller bearing efficiency is assured at operating temperatures up to 500° Fahr.

Of a buttery consistency at room temperature, MASED LUBRICANT No. 177 defies the usual liquifying action of heat. *Give it a HOT SPOT test!* Center a piece of pea size on an electric hot plate! MASED *remains* buttery while other greases melt and run away.

MASED LUBRICANT No. 177 has a definite place in the lubrication of textile drying machinery, kiln and oven cars and innumerable types of equipment subjected to high temperature conditions.

● *Get more facts about this unusual Lubricant.*

BORNE SCRYMSER COMPANY
ESTABLISHED 1874
17 BATTERY PLACE • NEW YORK

Industrial Lamp

HIGH-INTENSITY FLUORESCENT FIXTURES use two 100-watt, 60-in. fluorescent lamps, and are built of extra-heavy gage sheet steel. Provided with white vitreous-porcelain-enamel reflector, and has open ends, making it adaptable to strip mounting. Units corrected for power factor and stroboscopic effect, and equipped with latest Tulamp ballasts, starters, sockets, etc. Come completely wired, ready for hanging. *Mitchell Mfg Co, 2525 Clybourn Ave, Chicago, Ill.*

Tape

TWO-IN-ONE TAPE is combination of splicing compound and friction tape, and is made with rubber insulation on both sides of strong cotton tape. Rubber is special quality, with no free sulphur in it to cause corrosion of copper wires. According to maker, single thickness provides insulation for voltage up to 220, and a double thickness is ample for voltages up to 660. *B F Goodrich Co, Akron, Ohio.*

Terminal Strips

SIX-BARRIER STRIP SERIES used for interconnection of electrical circuits, where maximum metal-to-metal spacing is required. Body is heavy molded Bakelite, with barriers between each set of terminals, following around strip edge of and terminating with base. *Howard B Jones, 2300 Wabansia Ave, Chicago, Ill.*

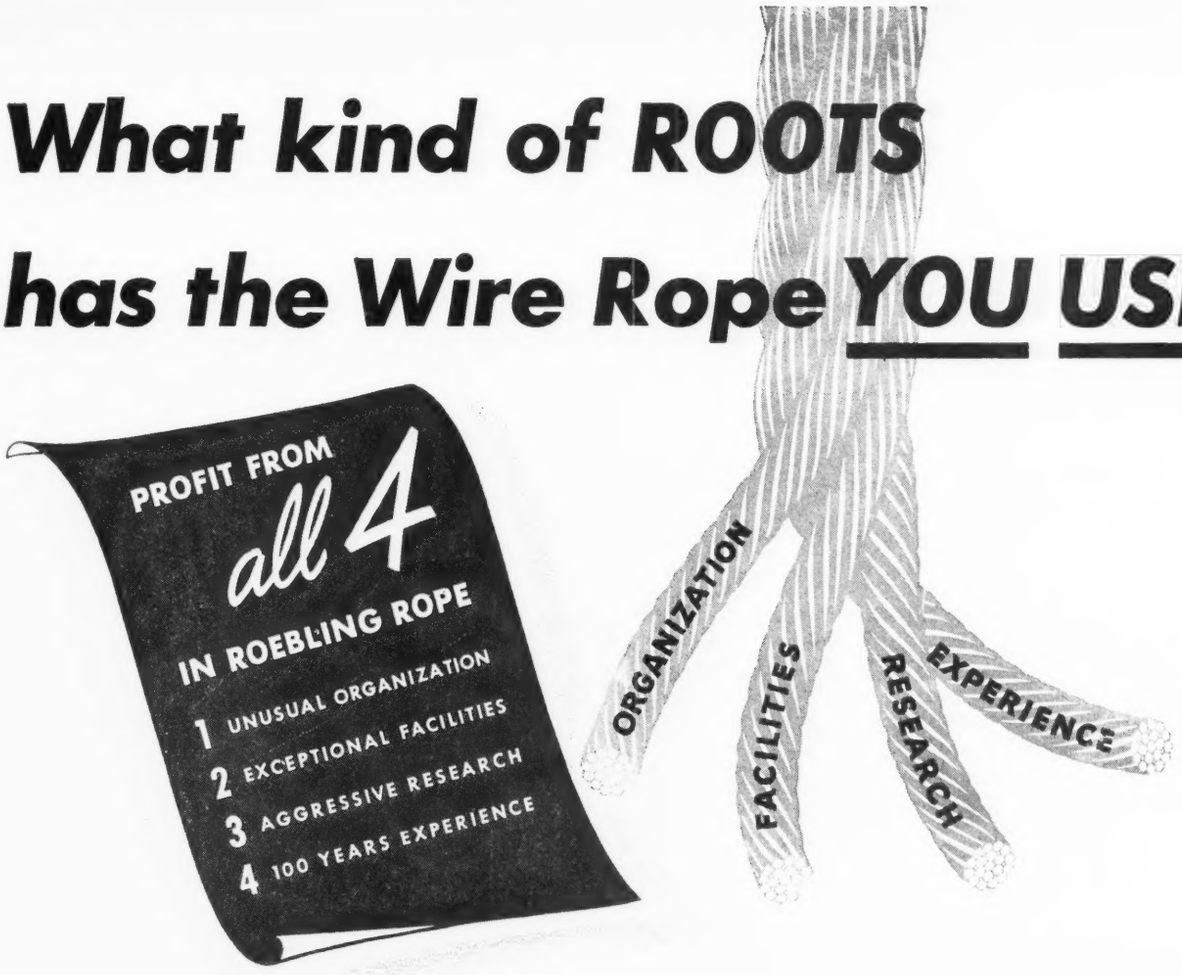
Recorder

LOW-CHART-SPEED recorders telescope 30-day load and voltage surveys, formerly requiring 60-ft strip chart, into chart 30 in. long. Instrument, addition to G E's line of CF inkless recorders, has chart speed of only 1-in. per day. Thus, operating record for entire month can be checked at a glance, and spread of current or voltage is immediately obvious. Recorder is available as ammeter or voltmeter. *General Electric Co, Schenectady, N. Y.*

Instrument Charts

PERMOCHART, recently improved design of recording instrument chart made for continuous re-use, now made in three colors

What kind of ROOTS has the Wire Rope YOU USE?



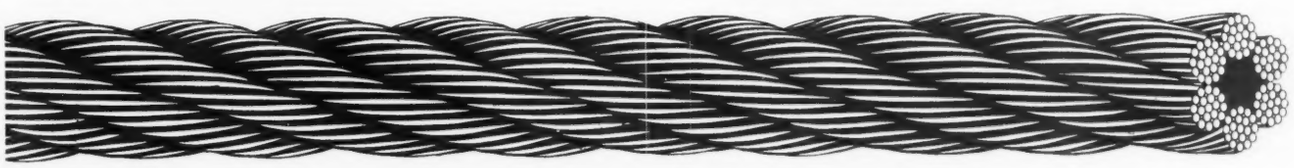
THE "ROEBLING 4" speak for themselves. Here are the roots from which Roebling "Blue Center" Steel Wire Rope has developed—the finest wire rope that money can buy.

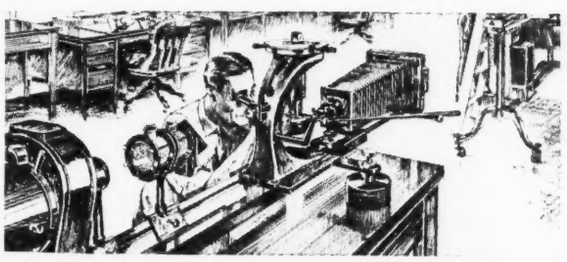
Profit from this unequalled combination of advantages. The use of Roebling "Blue Center" will assure you of rock-bottom *general average* rope operating cost.

ROEBLING

"Blue Center" STEEL

WIRE ROPE





KEEPING AHEAD—BY LOOKING AHEAD!

There is nothing static about Roebling "Blue Center" Wire Rope. It is constantly being developed and improved. We keep it ahead—by looking ahead, with Research.

Roebling wire rope research is carried on continually, on a planned basis—in one of the country's most modern and completely equipped industrial research units.

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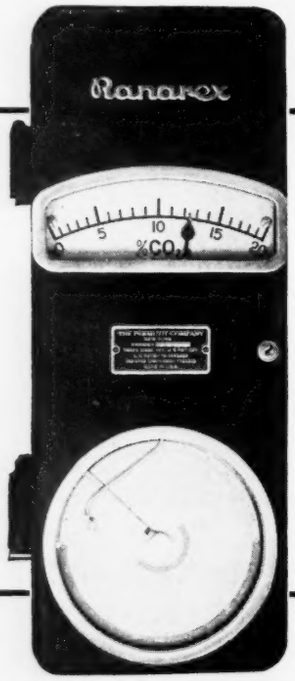
Stepping up power-loads?
You'll need this 3-shift dependability

RANAREX*

RUGGED because there are no chemicals or fragile parts to get out of order. Operates on lighting circuit.

QUICK accurate readings—within 3/10 of 1% CO_2—in 30 seconds. Makes big savings on fuel costs.

the only mechanical
CO_2 INDICATOR and RECORDER



Write for free booklet to The Permutit Company, Dept. A, 330 West 42nd Street, New York, N. Y.

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product of
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of "Vinylite" plastic, to reduce glare and eyestrain. Colors are green, ivory and blue. Charts can be used without instrument changes, as they are inserted and removed similar to paper charts. Charts guaranteed for period of two years under normal working conditions. *Permochart Co, 542 Chestnut Rd, Sewickley, Pa.*

Floor Grating

KLEMP WELDED-STEEL grating is made of hot rolled hexagonal steel bars placed at right angles on top of flat bearing bars set on edge, then electro-welded under pressure. All joints are smooth, yet bearing bars and upper hex angle of rod make efficient non-slip surface. Grating is made with bars on $1\frac{3}{16}$-in. centers, in panels 24 in. wide and lengths to 35 ft. *Wm F Klemp Co, 6611 S Melvina Ave, Chicago, Ill.*

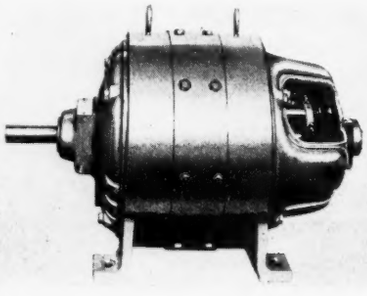
Oil Filter

PUROLATOR DUPLEX filtering unit designed for places where installation requires large filtering area in small space. Large filtering area attained by using two elements in each unit in parallel, one metal element

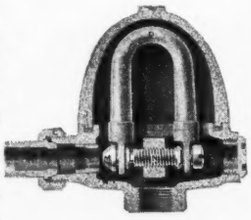
inside another of larger diameter, in telescopic fashion. Unit has control valve which is used for cutting out one element while other is disassembled for cleaning purposes. *Purolator Products, Inc, Newark, N. J.*

Exciter

REGULATOR AND EXCITER combined in one unit used for steel mill drives and other applications. Rotating regulator reduces first cost of generator or motor installation



HAINES TRAPS



Our Factory Type Trap has been serving Industrial users for years. Haines Traps have employed the well known Bourdon Tube as the thermostatic member for half a century. They are so accurate that a change of one degree in temperature will put the Trap into immediate action. Today, more than ever, economical use of steam is necessary to save fuel-oil and coal. This Trap is the solution to your steam problems. Write for details and catalog.

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(Please mention Power)

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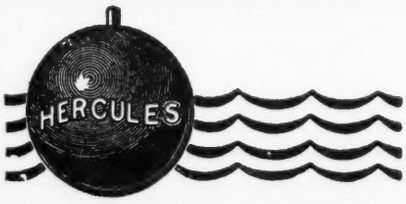
Seamless Copper
FLOATS



GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

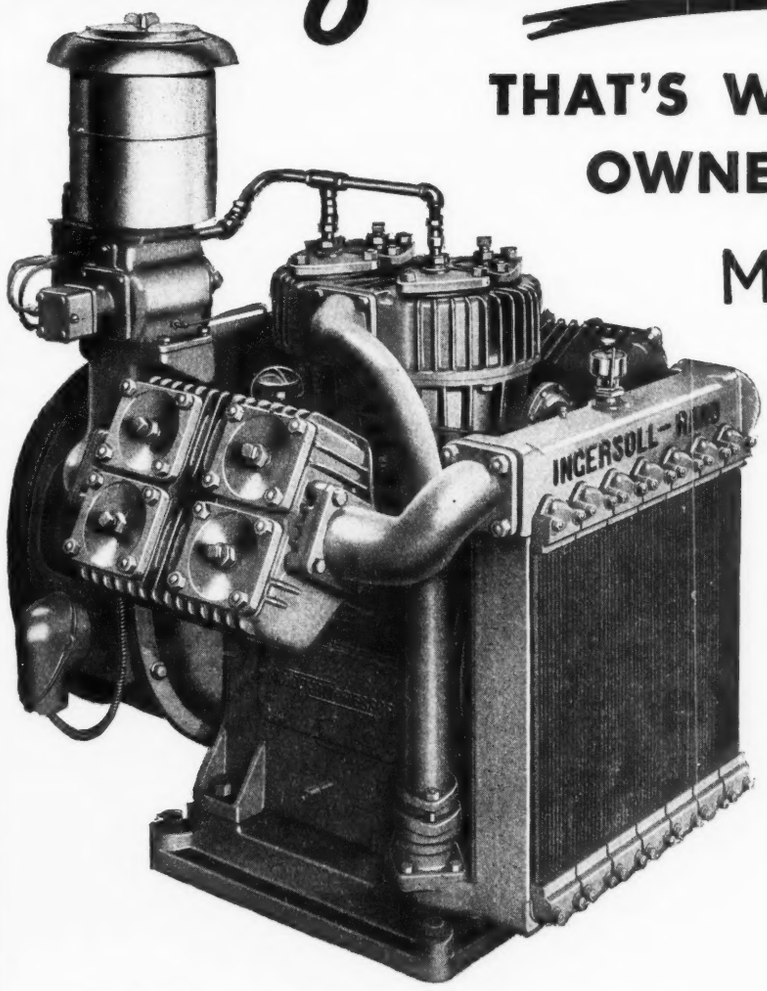
You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

"—doing a remarkable job"

THAT'S WHAT HUNDREDS OF OWNERS SAY ABOUT THE MOTORCOMPRESSOR



The MOTORCOMPRESSOR has a built-in electric motor. Other models are direct-coupled or are V-belt driven from motor or engine.

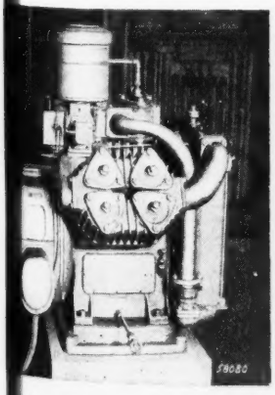
ENGINEERS who have been operating heavy, horizontal compressors are always amazed at the performance of the modern Two-Stage Air-Cooled Type 40 Compressor.

Though compact and light in weight, the Type 40 has such quality features as two-stage compression, die-forged crankshaft and connecting rods, Timken tapered-roller bearings, Channel Valves and precision manufacture throughout. Combined they assure high operating efficiency and reliability.

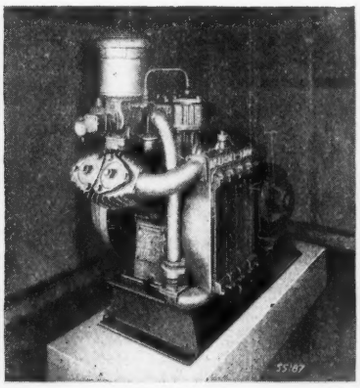
Because of its automatic lubrication and regulation features it requires but little attention.

If you need a compressor of from 60 to 400 cfm capacity, you can't afford to overlook the Type 40. Ask for Bulletin 3166-A.

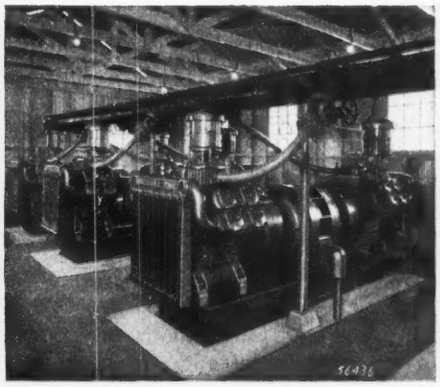
Type 40's Solve Air-Compressor Problems Like These:



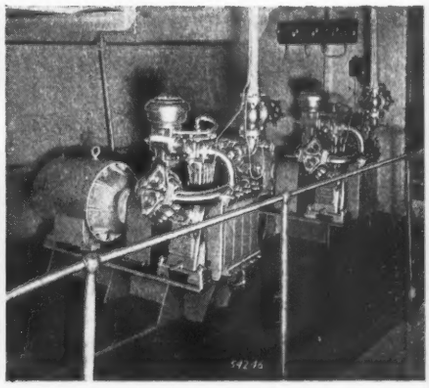
● **COMPACTNESS** was necessary in this eastern railroad terminal. A 50-hp Motorcompressor was installed.



● **NO COOLING WATER.** This Type 40 is installed in an unheated shed. Being air-cooled, it cannot freeze up.



● **EASY TO RELOCATE.** This construction job used Type 40's because they could be temporarily installed on an inexpensive foundation.



● **LIGHTWEIGHT** units are necessary aboard ship. This pair of 15-hp Type 40 compressors supplies service air for a tanker.

1-80

Atlanta, Birmingham, Boston, Buffalo, Butte, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Duluth, El Paso, Hartford, Houston, Kansas City, Knoxville, Los Angeles, Newark, New Orleans, New York, Philadelphia, Picher, Pittsburgh, Pottsville, Salt Lake City, San Francisco, Scranton, Seattle, St. Louis, St. Paul, Tulsa, Washington

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CAN THEY HEAR YOUR PLANT A MILE AWAY?

Do neighbors object to internal combustion engine exhaust noise or steam blow-off roar at your plant? Is this problem even more acute now because you have gone on a night shift and have to operate during the quiet night hours when the outside noise level is low?

WOULD YOU LIKE A SURE-FIRE SIMPLE ANSWER TO THIS PROBLEM?

Maxim Silencers provide this answer by cutting such noises to a whisper without in any way impairing the efficiency of the equipment to which they are attached.

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92 Homestead Ave., Hartford, Conn.

Please send details on your silencers for EXHAUST ☐ Internal Combustion engine ☐ Steam Engine ☐ Compressor Intake ☐ Steam Blow-off.

Name .....

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Address .....

because of 2-in-1 feature. Consists of differential amplifier for controlling excitation on dc motors and generators to give constant voltage, current, speed or tension. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

Synthetic Coating

CORROSION-RESISTANT SYNTHETIC is said to provide superior protection. Roxaprene in tests, according to maker, was unaffected after 600 hours in 2% caustic solution, and showed signs of failure only after 96 hours in a dilute hydrochloric-acid solution that ate through galvanized coatings in 2½ hours. Compound can be applied like paint finishes, by dip, spray, or roller coat, and air-dries quickly. *Roxalin Flexible Lacquer Co, Elizabeth, N. J.*

News Briefs

FPC Report Analyzes Installed Water Power

The recent report by the Federal Power Commission analyzes the installed water power in the United States and outlying territories. This report covering plants of 100 or more horsepower, shows that the total installed capacity of water-power plants in the United States and the outlying territories was 19,015,101 hp at the beginning of the year.

The total capacity for the United States on that date, the report shows, was 18,868,027 hp which is a net increase of 367,773 hp over total capacity reported January 1, 1940.

Largest net increases to installed water during 1940 were in the following five states: Tennessee, 106,125; North Carolina, 78,945; Oregon, 72,875; Pennsylvania, 42,424; and New Mexico, 34,390 hp.

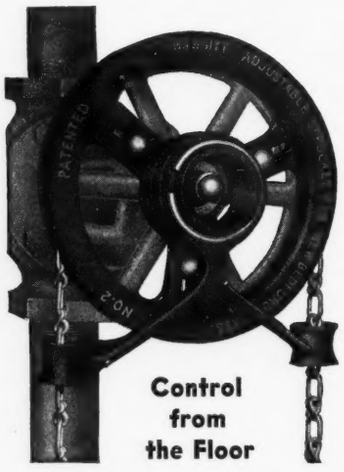
Annual Increase

The annual increase in installed capacity of water wheels since January 1, 1926, has varied between 4100 hp in 1935 and 1,275,530 in 1928. The average annual increase for the 15 year period, January 1, 1926 to January 1, 1941, is approximately 513,000 hp.

California with a total installed water-power capacity of 2,438,261 hp, representing 12.9% of the United States total, ranked first among the 48 states. New York, Washington, Alabama and North Carolina also had installed water-power capacity in excess of one million horsepower each.

Of the total water-power capacity in plants of 100 hp or over in the United States, 88.8%, or 16,747,053 hp is in-

Make Your Overhead Valves SAFE And Easy to Reach---



With the Babbitt Rim for Valves you eliminate danger and banish the stepladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

BABBITT STEAM SPECIALTY CO.
New Bedford, Mass.

What is the most important feature of a high temperature cement?

ANSWER:

HIGH BONDING STRENGTH

. . . because the length of service life obtainable from a furnace lining can only be in proportion to the bonding strength of the cement used to bind the brick. Recent impartial laboratory tests showed by the average modulus of 5 test joints that

ADAMANT
FIRE BRICK CEMENT

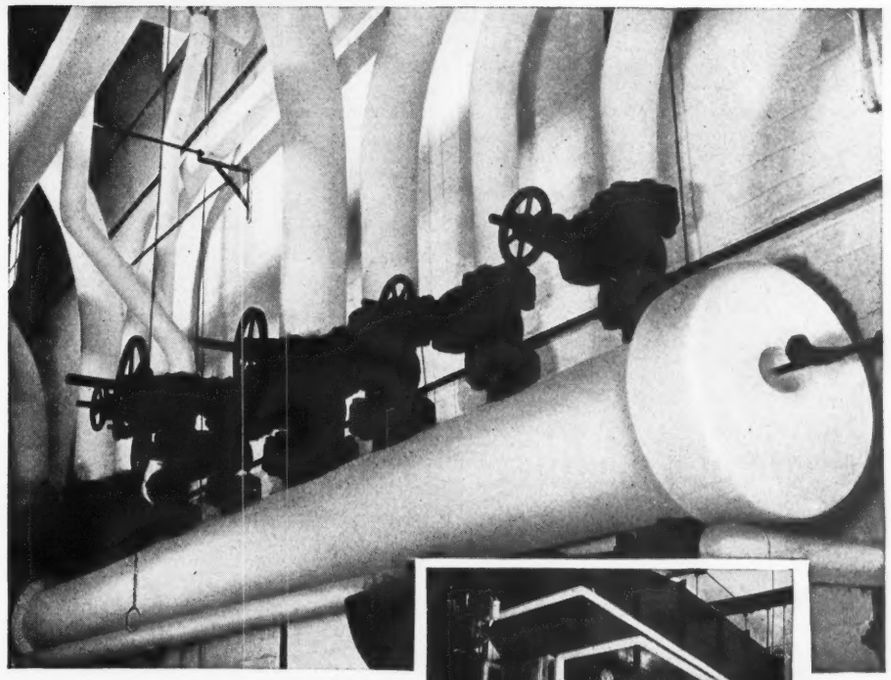
has a BONDING STRENGTH of 800 lbs. per sq. in. at room temperature. 1270 lbs. per sq. in. at 2600°F. This great strength of Adamant assures joints strong as the brick they bond. Adamant is smoother, too. Over 66% of the dry material passes through a 200 mesh standard Tyler sieve. For more facts about Adamant and other AdaProducts write

BOTFIELD
REFRACTORIES COMPANY

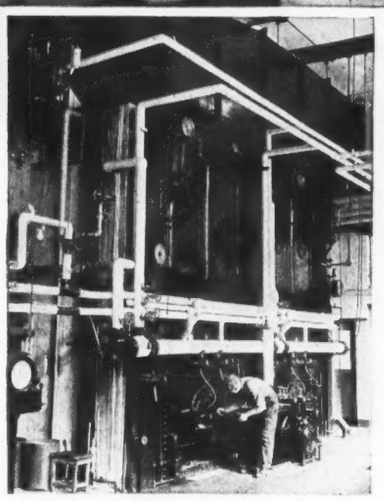
784 S. Swanson St., Philadelphia, Pa.
In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto.

BECAUSE IT INSULATES BETTER...

K&M insulation, exclusively, is used by this manufacturer of fine medicines



• Main steam line in the plant of Hoffmann-LaRoche, Inc., Nutley, N. J., showing how it is insulated with Keasbey & Mattison "Featherweight" 85% Magnesia. Approximately 350 feet of this line runs along an underground tunnel.



• Furnace and steam lines in the same plant, both insulated with K&M materials. Steam temperature is 380°F. All materials were applied by the plant's own maintenance department.

In producing the fine medicines for which they are known the country over, Hoffmann-LaRoche, Inc., rely on efficient heat insulation to help maintain precise control of process temperatures with maximum fuel economy.

More than eight years ago this company standardized on Keasbey & Mattison insulations, after experience with these and other products had shown the superior insulating qualities of K&M.

Boilers, steam lines, and process equipment are wholly insulated with K&M "Featherweight" 85% Magnesia and K&M insulating cements. All cold water and drain pipes are protected with K&M nonsweat pipe coverings. The result has been greater ease of quality-control with improved operating economy.

This is typical of the experience of industrial users generally. Because K&M products are specialized, and are recommended on the basis of an engineering analysis of the specific problems in each plant, they almost invariably show substantial savings in fuel cost.

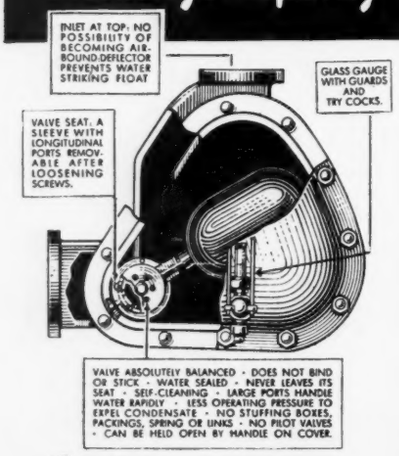
K&M engineers, working with K&M Distributors strategically located for quick service, can point the way to real savings in your plant, too. Write Dept. 11 for full details.

K&M "Featherweight" 85% Magnesia

KEASBEY & MATTISON

COMPANY, AMBLER, PENNSYLVANIA

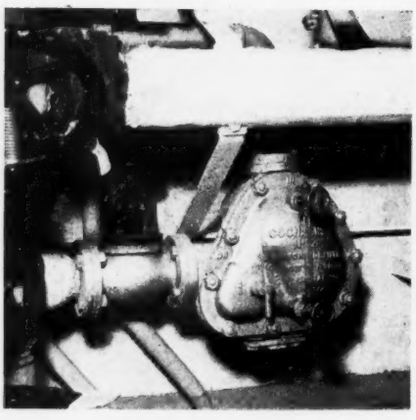
Extraordinary Discharge Capacity


INLET AT TOP: NO POSSIBILITY OF BECOMING AIR-BOUND. DEFLECTOR PREVENTS WATER STRIKING FLOAT
GLASS GAUGE WITH GUARDS AND TRY COCKS.
VALVE SEAT, A SLEEVE WITH LONGITUDINAL PORTS REMOVABLE AFTER LOOSENING SCREWS.
VALVE ABSOLUTELY BALANCED · DOES NOT BIND OR STICK · WATER SEALED · NEVER LEAVES ITS SEAT · SELF-CLEANING · LARGE PORTS HANDLE WATER RAPIDLY · LESS OPERATING PRESSURE TO EXPEL CONDENSATE · NO STUFFING BOXES, PACKINGS, SPRING OR LINKS · NO PILOT VALVES · CAN BE HELD OPEN BY HANDLE ON COVER.

Cochrane

MULTIPORT DRAINER

for *Quick* Drainage of *Large Quantities* of Condensate . . .



THE "Multiport" principle on which the Cochrane Drainer operates is that of a hollow cylindrical valve with a number of longitudinal ports which register with similar ports in the valve seat when the float is in the raised position. The combined capacities of these ports is unusually large, which accounts for the valve's extraordinary discharge capacity. For complete details mail this coupon.

COCHRANE

Cochrane Corp., 3106 N. 17th St., Phila., Pa.
Please send me copies of your publications on Condensate Drainage

Name.....

Firm.....

Address.....

City.....State.....

stalled in plants having 5,000 hp capacity and over; 8.3%, or 1,574,552 hp is installed in plants from 1,000 to 5,000 hp capacity; and the remaining 2.9% or 546,422 hp is installed in plants of from 100 to 1,000 hp capacity.

In terms of the number of plants, however, the situation is reversed, the report shows. Of the total number of plants of 100 hp or more in the United States 57.6% or 1,613 plants are in the group of with capacities between 100 and 1,000 hp; 24.6% or 688 plants are in the group with capacities from 1,000 to 5,000 hp; and 17.8% or 500 plants were in the group with capacities of 5,000 hp and over.

Semi-Conducting Paint Kills Insulation Corona

Elimination of corona in air spaces between the end turns of coils in windings of rotating machines has been accomplished by treating the end-turn insulation with "Coronox," a semi-conducting paint. Since machines of above 10,000 volts came into use corona has been a troublesome element in high-voltage generating equipment. Resulting from ionization of electrically overstressed gases, corona may appear in any of three locations: in the core slots, around coils immediately beyond the ends of the slots, and in the air spaces between coils of the end winding. By treating the slot portions of the coils with a semi-conducting compound, such as a suspension of colloidal graphite in water, corona in the slot sections may be eliminated.

Application of this treatment to the whole end winding is not satisfactory, for it produces a low-resistance path to ground, which in effect brings the surface of the end turn close to ground potential. This impresses nearly full phase voltage on the end turn insulation, which because of its bends and joints, cannot be insulated as effectively as the slot portion of the coil.

An ideal solution to the problem would be to have the resistance of the end-turn insulation graded. That is, starting at a low value at the slot and gradually increasing to high amounts at the extremity or loop of the coil. Commercially, uniform grading of insulation resistance is not easy to obtain.

A resistance value, such as 10 megohms per square inch of the semi-conducting paint, can reduce the voltage stress across the end turn insulation sufficiently to eliminate corona. In treating the stator coils, glass binder tape is completely filled with semi-con-

"STANDCO" PILLOW BLOCKS

Fig. 1635

Combining clamp block and pillow block requirements in one type, the "Standco" shown above is sturdily built and is offered in a wide range of sizes. Babbitted bearing surfaces are finished beautifully smooth, both faces machined. It can be depended on for long, trouble-free service.

"Standco" Ball and Socket Pillow Block, Ring or Wick Oiling, Plain or Collar End Babbitted Bearings.

Fig. 32

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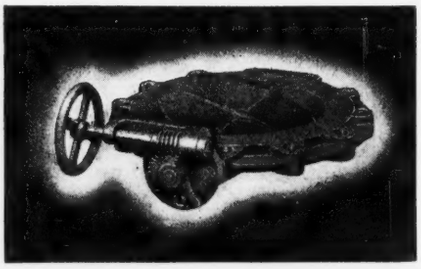
STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA.

Boston, Chicago, Detroit, Box 577, St. Louis, Indianapolis, San Francisco



If it's a Blast Gate ROCKWELL makes it

ROCKWELL'S complete line of Blast Gates includes all types: Slide, Kwikleen, Wafer, and Butterfly, in sizes up to 48". They are quick and easy to operate— strong, light, and durable. They can be supplied in monel, bronze, stainless steel and other alloys to meet individual requirements.

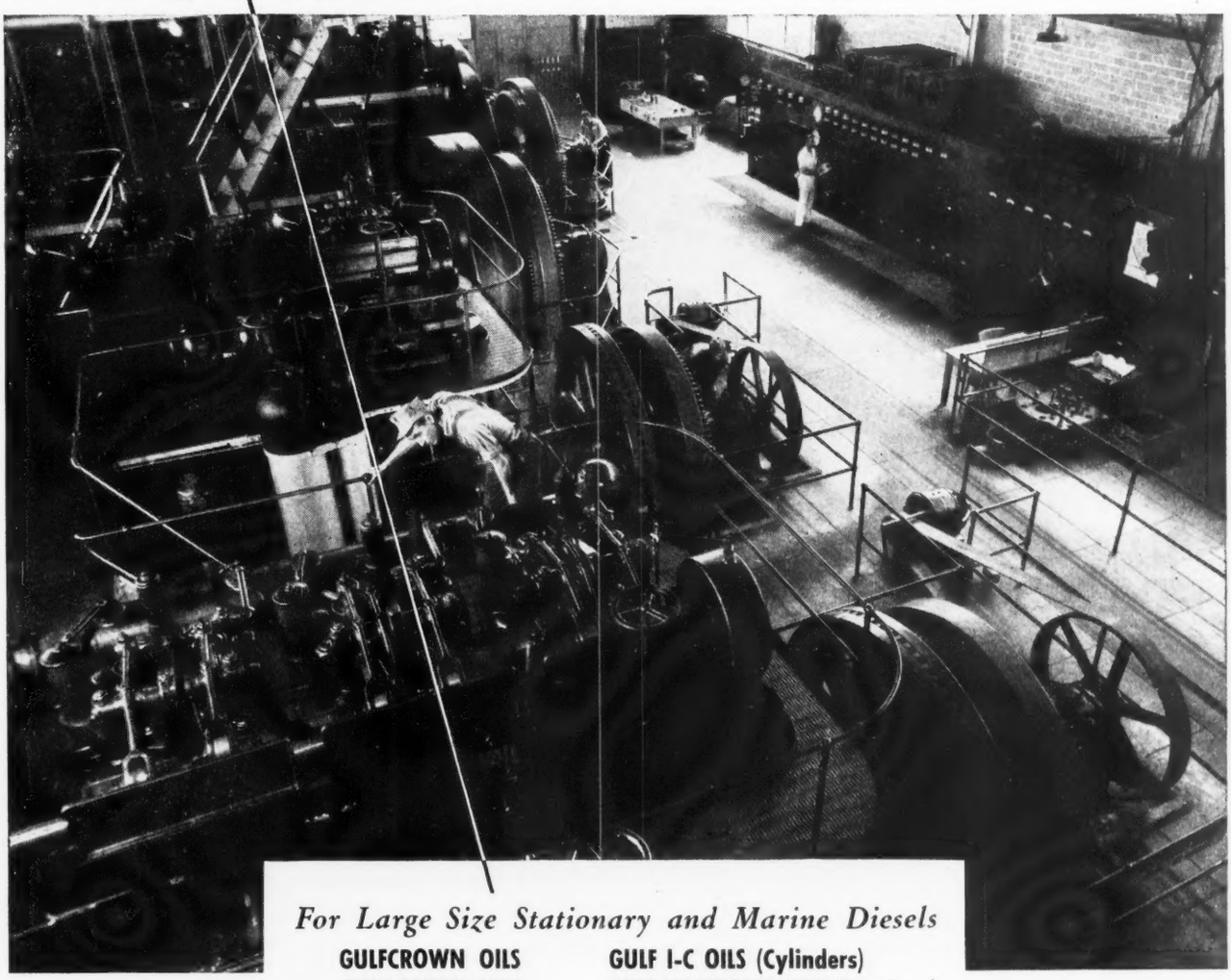
Send for Catalog No. 4020

W. S. ROCKWELL COMPANY

Blast Gate Division

90 CHURCH STREET NEW YORK, N. Y.

For Minimum "Down-Time"... USE GULF DIESEL OILS



For Large Size Stationary and Marine Diesels

GULFCROWN OILS — **GULF I-C OILS (Cylinders)**
GULF PARVIS OILS — **GULF HARMONY OILS (Bearings)**

For Small Mobile, Stationary, Marine or High Speed Diesels

GULFPRIDE OILS — **GULF RINGFLEX MOTOR OILS***
GULFLUBE MOTOR OILS — **GULF RINGZONE MOTOR OILS***

* New detergent type oils.

THE *greater value* of Gulf Diesel lubricating oils shows up under today's conditions—when power demands can be met only by continuous heavy-load operation of power units. For severe service proves the endurance and resistance to decomposition of these oils. They retain their lubricating qualities under conditions which would cause ordinary oils to deteriorate quickly. Thus, Diesel operators find that they have *less down-time* and *lower maintenance expense* with these oils in service.

Are you looking for maximum protection of your Diesels? Ask a Gulf engineer to give you his recommendation for their proper lubrication. Backed by a thorough knowledge of the lubrication requirements of all types of Diesels under varied operating conditions, he can help you get uninterrupted service and fewer repair bills.

The Gulf line of more than 400 quality oils and greases is quickly available to you through 1200 warehouses located in 30 states from Maine to New Mexico. Write or 'phone your nearest Gulf office today.

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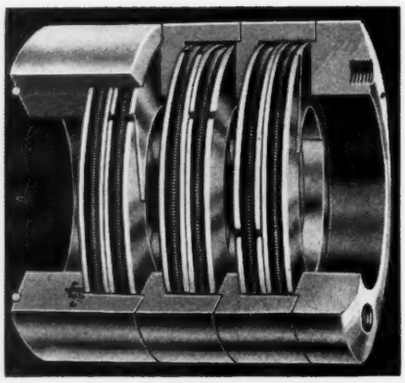
GULF REFINING CO.
Gulf Bldg., Pittsburgh, Pa.



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Specify France "Full-floating" Metal Packing for reciprocating piston rods as well as reciprocating or oscillating valve stems and obtain sealing efficiency of the first rank. There is a proven France design for any type of engine, pump or compressor.

Promotes top level production
Prevents costly shutdowns
Protects product uniformity

ORIGINAL FRANCE METAL PACKING
Sold on approval
Satisfaction Guaranteed

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Original **FRANCE METAL PACKING**

Dr C H Hill, Manager, insulation division and Dr L J Berberich, Westinghouse research engineer compares the coils of high-voltage generators. The right-hand coils have been treated to prevent formation of corona.

ducting paint which results in a thick firmly anchored, semi-conducting layer on the surface of the coil. The parallel connecting rings and support rings are treated in a similar manner. Finally, a long life insulating varnish is sprayed over the whole end winding to protect the semi-conducting paint and increase its stability.

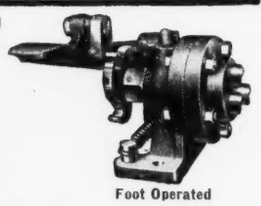
Two often measured properties of electrical insulation are the flash-over voltage and the breakdown voltage. The flashover voltage of semi-conducting-paint covered surfaces is actually greater than that of highly insulating surfaces. The breakdown voltages for treated coils should be higher than for untreated coils because the paint treatment eliminates concentrated voltage stresses at the edge of the slot.

Circuit Breakers Used in Cascade

As power systems grow larger and more complex, their protection becomes more difficult. A new solution to the problem of providing adequate short-circuit protection for low-voltage distribution systems and circuits operating at 600 volts and less was presented by A E Anderson and C H Black of the General Electric Co at the American Institute of Electrical Engineers'

NICHOLSON

Lever Operated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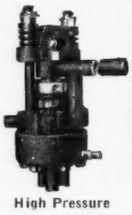
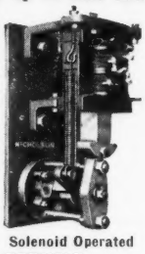
Available in TWO, THREE, FOUR-WAY and Special Types for operating Air, Steam, Water or Oil Cylinders on pressures up to 5000 lbs. Made in five different metal combinations to cover all mediums handled. Non-corrosive metals are used in all vital parts. Gaskets and gland packing suitable for each specific service are used.


High Pressure


Solenoid Operated

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Non-slip, sharp top edge, self-cleaning cross bars like the ridge of a roof give you the maximum in safe traction. Other features your Batesgrate dollars buy are—maximum open area for light and air—no grooves or rough burned metal to catch grease or dirt—fillet weld, the strongest type—no cracks, joints, or crevices, therefore, easily maintained—smooth, clean appearance. Get all the important details from Catalog No. 937—Write today.

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WALTER BATES COMPANY
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fabrication
HAS TO BE GOOD FOR 1500 lb. SERVICES

THIS pair of assemblies for a large central station's boiler feed lines exemplify many of the operations in fabricating high pressure piping that must be performed with precision and care. When hot bending the pipe, the temperature and bending rate are carefully controlled to hold the outside wall to a definite specified thickness and to form the bends accurate to template. All ends of the pipe are accurately machine beveled and fitted with machined backing rings for welding. Forged steel tees and Y's are machined from solid billets. Correct welding procedure and subsequent stress relieving insures proper metallurgical characteristics in the finished assembly. All inside pipe surfaces are thoroughly cleaned by grit blasting.

Pittsburgh Piping has complete facilities for performing all these operations in its own shop. Trained field crews are available for competent field erection. Consult Pittsburgh Piping & Equipment Company for your next requirements.

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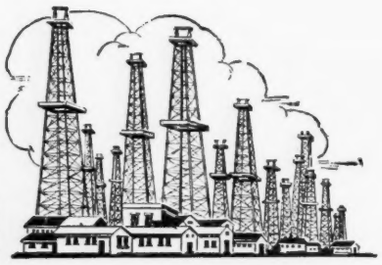
FOR OIL



NOW, when every production minute has an increased value, no plant can afford to have unnecessary delays and equipment failures caused by inadequate packings. That's why it is important to pack with Belmont—the packings that are pre-planned for service.

Below are two of the many Belmont Packings especially made for Oil Services, packings that will perform their tasks faithfully—even under the strain of 24-hour-day operations. Both Belmont 6100 and 189 are made from selected high grade asbestos yarn, braided, and treated with an exclusive lubricant for ultimate wear and greater efficiency.

The complete line of Belmont Packings (for all types of services) is illustrated and described in detail in Belmont Catalog No. 40. Write for a FREE copy on your company letterhead today! Any Belmont distributor will be glad to show you samples and help you with your particular packing requirements.

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THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

FOR
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BELMONT 6100
For rod and valve stems handling volatile distillates such as gasoline, kerosene, naphtha, and benzol.
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For rods and plungers handling hot or cold oil—all temperatures.

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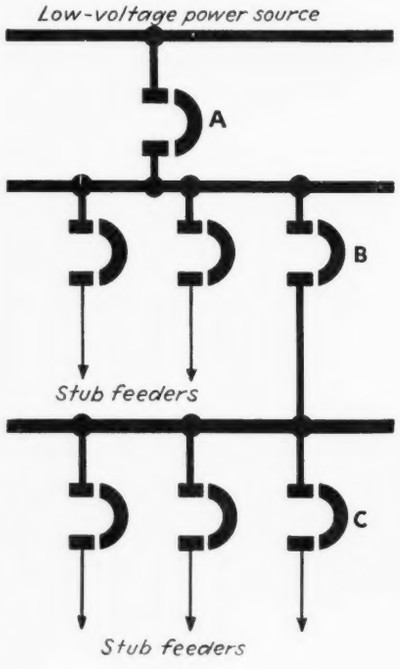
summer convention. Recent tests and field experience have dispelled the illusion that protective devices of very limited interrupting ability will satisfactorily protect any low-voltage circuit.

A recently published calculating procedure makes possible the accurate determination of the short-circuit current obtaining in low-voltage circuits or systems. Modern types of low-voltage air circuit breakers in a wide range of interrupting ratings are now available. While the best short-circuit protection is obtained by selecting those of interrupting ratings at least equal to the calculated short-circuit current, such a procedure is not always justifiable.

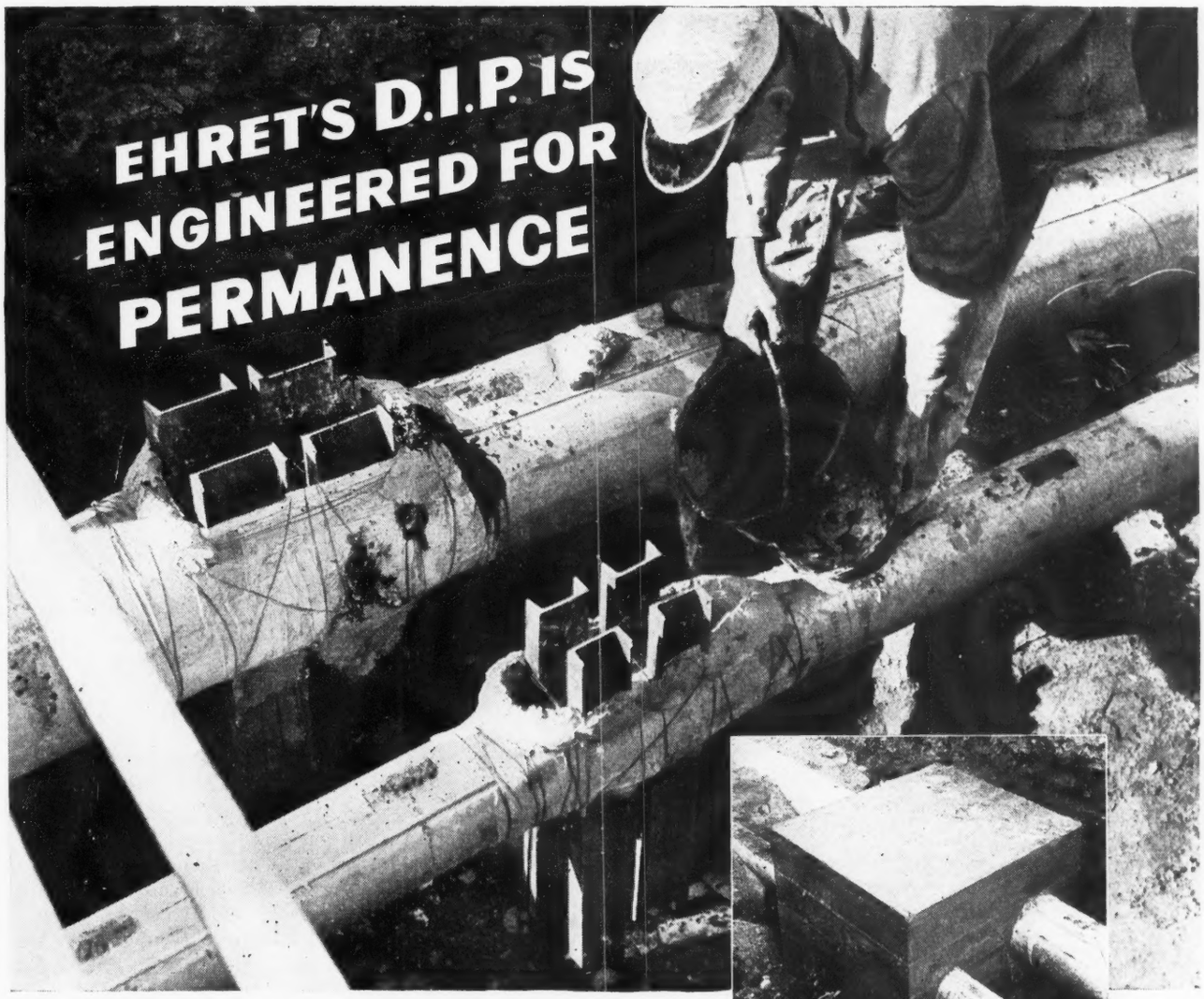
In many instances a relatively large number of main-feeder circuits, emanating from a bus fed through one or more main circuit breakers or incoming line breakers, supply an even larger number of branch breakers. The short-circuit current obtainable at the branch feeder breaker locations may not be materially less than those obtainable at the main bus. Yet, the selection of branch-feeder breakers, or possibly even main-feeder breakers with interrupting ratings high enough to match these obtainable currents, may prove completely impracticable when viewed with any reasonable regard for space requirements or costs.

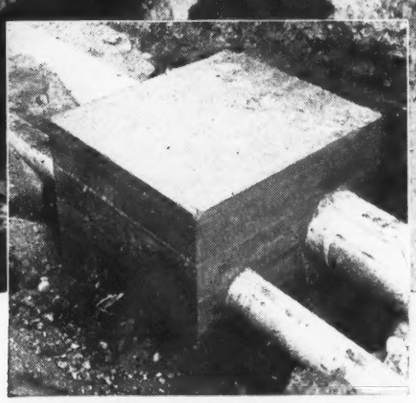
Cascade Breakers

Many circuit breakers of varying interrupting ratings, properly coordinated in design may be used in a cascade or series connection as in the diagram, in such manner that in event of a severe fault, the main breaker *A* backs up the smaller main feeder breakers



FOR UNDERGROUND PIPE LINES

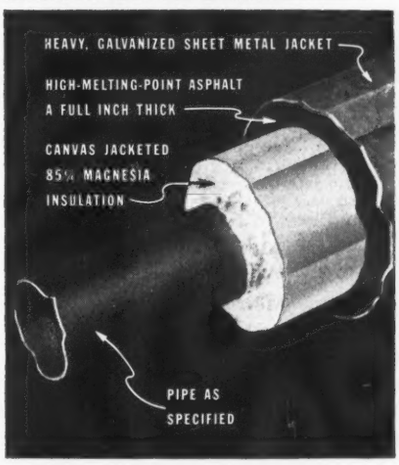




THE PERMANENT character of the Durant Insulated Piping System is not based solely on the design of the factory-fabricated units. Full consideration has been given to the varied requirements of field assembly. The accompanying installation photographs of a two-pipeline anchor are illustrative of the engineered adaptability of the D.I.P. system.

In the large illustration, the two insulated joints are being sealed with asphalt a full inch thick. After pouring, the pipes with steel anchoring channels are encased in mass concrete to provide the inexpensive, effective anchor shown at upper right.

[*Send for the Ehret D.I.P. Booklet. It contains full information on this modern system of underground insulated piping.*]



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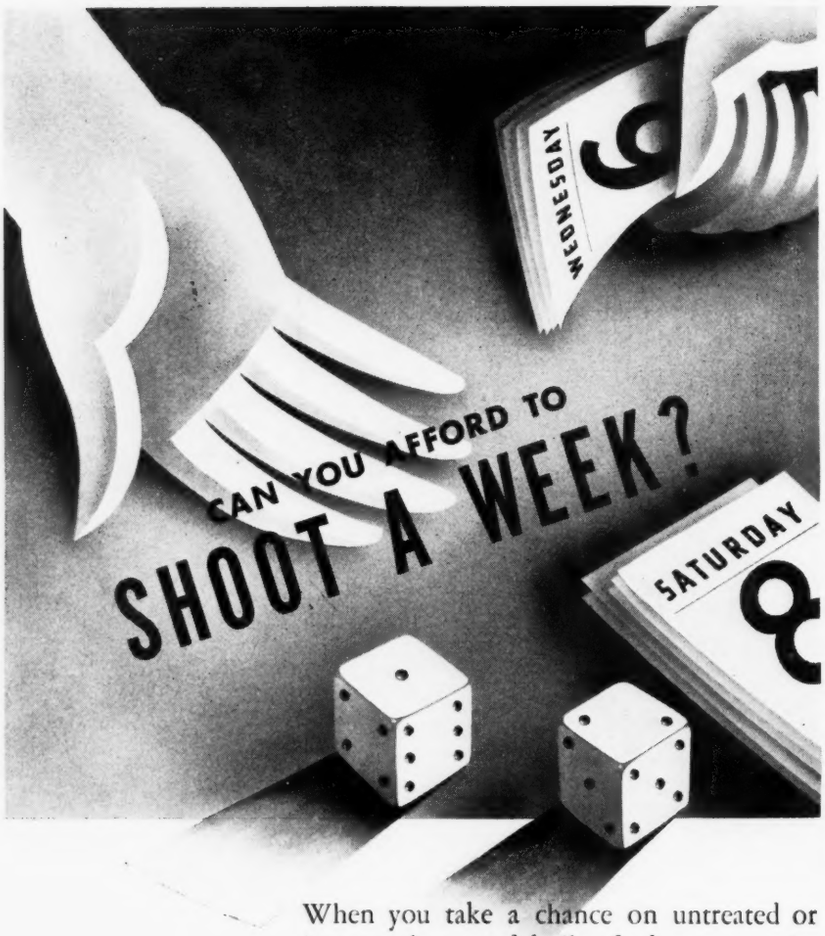

When you take a chance on untreated or improperly treated boiler feed water, you're risking more than costly repairs. You're taking a chance on a power shut down that might add weeks to your production schedules.

That's why so many plant engineers are turning to FERRISUL (anhydrous ferric sulfate).

Proper treatment with FERRISUL is one sure, safe, and easy way to rid your boiler feed water of silica and organic substances *without* danger of leaving scale-forming or corrosive residuals. Ferrisul's floc is highly adsorptive, forms immediately, settles rapidly, is stable over the entire pH range above 3.5, leaves no harmful coagulant residuals!

Dry and free flowing, Ferrisul is easy to handle... requires no expensive storage tanks ...and can be transferred on any standard conveyor system and introduced into the treatment in standard dry feed machines or in solution feeders. Write for booklet which gives complete technical details. MONSANTO CHEMICAL COMPANY, Merrimac Division, Everett Station, Boston, Massachusetts.

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.. Refer your water treating problems to Monsanto's technical department. Monsanto manufactures a full line of water-treating chemicals, is in a position to give sound, unbiased advice on your particular needs.

FERRISUL (anhydrous ferric sulfate)—an effective coagulant for treatment of boiler feed water, sewage, industrial waste, municipal water supply.

SANTOBRITE (sodium pentachlorophenate)—a sure and inexpensive algaecide and fungicide for the control of slime and algae in cooling water systems.

SANTOSITE (sodium sulfite anhydrous technical) a reducing agent for removing oxygen from boiler feed water

MONSANTO CHEMICALS
SERVING INDUSTRY... WHICH SERVES MANKIND

B, and these in turn back up the branch feeder breakers, *C*. Only the main breakers need have interrupting ratings equal to the obtainable short-circuit current, yet the system is adequately protected, within the limits set forth.

Cascading also makes possible a simple means of selecting air-break circuit breakers to provide economical yet adequate protection for relatively small installations, where a complete short circuit study might be difficult to justify and where a poor selection of protective devices would result in either an unnecessary expensive installation or a serious hazard.

It must not be assumed that any combination of air-break circuit breakers will operate effectively in cascade arrangement. They must be carefully and properly selected. For example, tests have revealed that the so-called thermal breaker when subjected to currents considerably beyond their rating, may clear the circuit, and yet if the current is too great, be destroyed during the first peak of 60 cycle current. Some users have been willing to accept this hazard, using larger breakers to protect the circuit only, and recognizing the impracticability of preventing damage to the thermal breakers. This, however, is not considered as true cascading, where one of the principles is that no breakers shall be damaged beyond repair nor shall any breaker constitute a potential hazard to the safety of personnel or adjacent equipment.

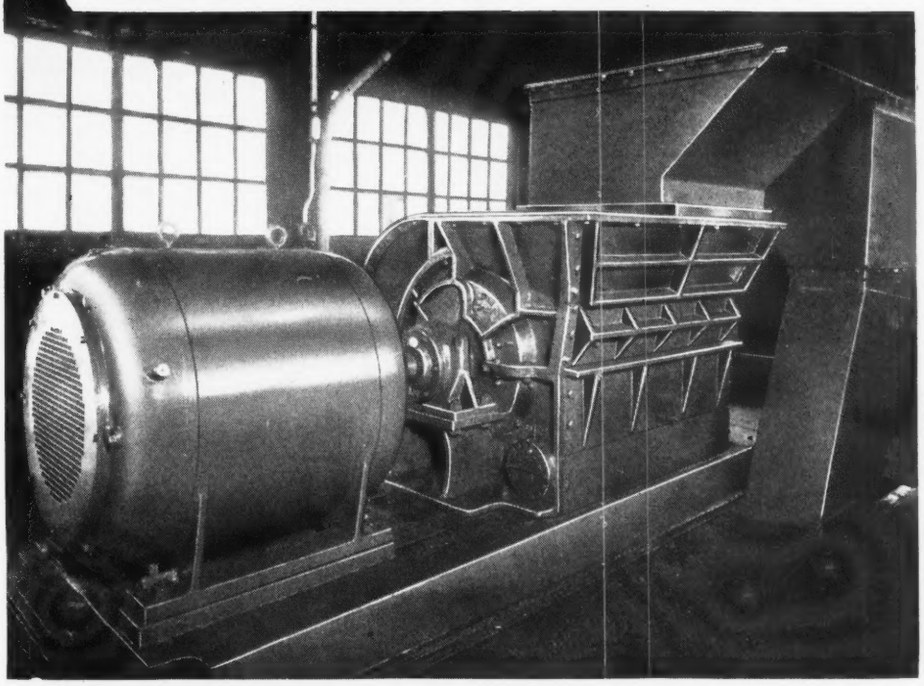
The following requirements may serve as a guide for the selection of air-break circuit breakers of the conventional magnetic type having characteristics that permit their use in cascade. The smaller breakers *C* in the figure must be capable of mechanically withstanding the impact resulting from the electromagnetic forces set up by the excessive current. This is much more readily accomplished if these breakers have a quick-acting instantaneous tripping means.

Quick-Acting Tripper

Having a quick-acting tripping means they should not otherwise be restrained from separating their contacts nor from transferring the current from contacts to interrupting units. The interrupting units must be capable of withstanding arcing for such times as the back-up breakers may require to interrupt the current.

Since the back-up breakers must protect not only the circuit but also the smaller breakers, they must trip whenever the current reaches a value equal to slightly less than the interrupting rating of the smaller breaker next in line.

GREATER PRODUCTION—MORE STEAM—LOWER STEAM COSTS



Installation in Prominent Eastern Public Utility

. . . through sizing coal the "AMERICAN" WAY

THE "American" Way has proved the economical way to properly size coal and step up production.

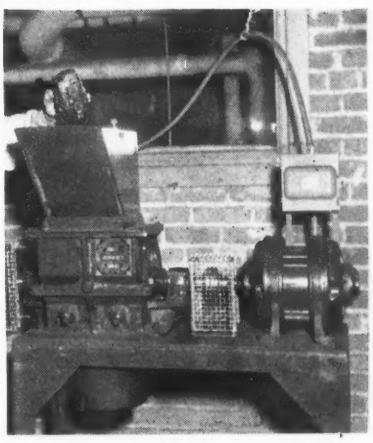
In leading plants all over the country, the installation of "AMERICAN" RING CRUSHERS has resulted in crushing coal at an average total cost of less than one cent per ton, including all charges for power, labor, maintenance and interest on investment.

Proper coal sizing with "AMERICANS" is achieved at low cost by an exclusive design of manganese steel shredder rings in suspension which apply centrifugal force at right angles to a horizontal shaft. These rings, with twenty cutting edges or teeth, strike, roll and split the coal before it reaches the breaker plates. A minimum of fines results. An adjustable breaker plate provides for varying the size of the crushed coal to meet specific firing conditions.

Of heavy steel construction throughout, with alloy steel main shaft, anti-friction bearings, and manganese steel crushing parts, "AMERICAN" Ring Crushers insure low maintenance, large crushing capacity and low power consumption.

"AMERICAN" Manganese Steel Shredder Ring which splits the coal.

INVESTIGATE *the "AMERICAN" WAY today as a practical, proved and economical way to step up power production.*



"AMERICAN" LABORATORY CRUSHERS

These units—available in "Rolling Ring and Swing Hammer types—are ideal for preparing coal samplers for test. They are also adaptable to shredding and pulverizing a wide variety of materials such as chemicals, clays, food products, minerals and many products. Full information is available on request.

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ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

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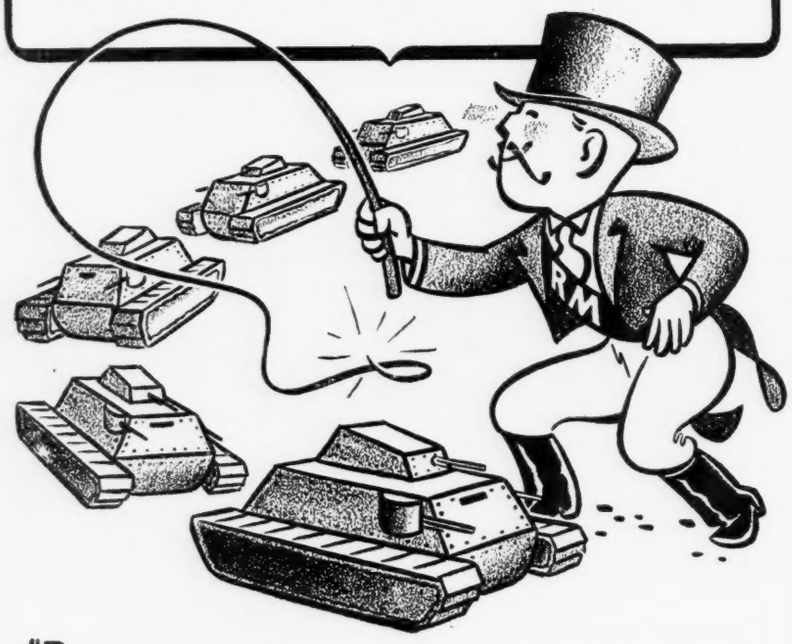
Win it with R/M Packings



"Produce" is the watchword. Drive every pump to its very limit. Hold every ounce of pressure. Delay every overhaul to the final minute. Get out the goods.

That's where R/M packings come into their own. They've won their nickname "Ring Master" by cracking whips over the tough assignments. Forty years of specializing in rubber and asbestos have built into them a toughness that lasts with the very minimum of abrasion. Whether you're holding steam or water, air or gas, or corrosive liquids, the R/M line has one number that is exactly suited to your job. The line is complete, but it has no duplicates. It is readily available through local outlets. It is your best bet to produce and keep right on producing. Try R/M on your very next repacking job.

This complete, photographic, condensed and cross-indexed catalog will show you exactly the R/M packing for each job. Your copy is free. Get one today by calling your R/M distributor, or by writing us for a copy.

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Makers of Packings for Every Industrial Use

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They must completely interrupt this current rapidly enough to avoid serious damage to the smaller breakers. A reasonable and effective solution is that the back-up breaker need not actually separate its contacts in less than the normal interrupting time of the smaller breaker next in line, so long as the current does not greatly exceed the rating of this smaller breaker.

Cascading Protection

Cascading of suitably coordinated air-break circuit breakers is a practical and economical system of protection for extensive low-voltage radial feeder system. Proper performance of breakers in cascade has been verified by tests and several years' experience with the system has been satisfactory, both from the standpoint of operation and maintenance.

It is true that in the cascade arrangement severe faults will occasionally trip the back-up breaker and thus interrupt power supply to some circuits not in trouble. However, this might happen even though circuit breakers with interrupting ratings to take care of the full short-circuit current were used in the same connection; but such faults are not common and most of the troubles will be taken care of by the individual-feeder breakers without tripping the back-up breakers and without the loss of service to the rest of the system.

Unique Diesel Train For Rio Grande R.R.

One of two new streamlined trains built for Denver & Rio Grande Western RR by Edward G. Budd Mfg Co was demonstrated for the press on a run from Jersey City to Trenton, Aug. 19. This unit, and another like it, will enter overnight service between Denver and Salt Lake City on Sept. 8.

Each of the two cars making up the 75-ft, 130,000-lb, 62-passenger train is self-powered by Hercules horizontal diesels, mounted below the floor. Use of General Electric drives, with newly developed amplidyne control, gives a 4-to-1 speed range while utilizing full engine output, thus insuring maximum performance over the extremely mountainous route. The forward car contains the control cab, baggage space and a reclining-seat coach section. The after car carries sleeper sections, two small bedrooms, an 8-place diner section and a small observation lounge. All space will be reserved and it is expected that the train will run full most of the time.

All Taylor Forge Fittings are critically inspected for circularity of ends, accuracy of dimensions, and smoothness of inside wall.
6"STD. TAYLOR FORGE WELDELL PAT. 1936805

An extra operation for us provides extra value for you in WeldELLS

ONE of the big reasons practical men prefer WeldELLS is because these *engineered* fittings line up so perfectly. And the reason WeldELLS do line up so precisely, so easily, is because every one is given a *truing operation* to bring the fitting to *exact* size before machining bevel and land. Incidentally that's also why both bevel and land are so accurate and uniform in WeldELLS.

Of course it costs us something to perform this operation—and we could "get by" without it. But we believe that the extra value provided fully justifies the expense.

So here again the Taylor Forge principles of sound engineering design, maximum simplicity, utility and economy, bring added value to users of welding fittings.

And remember that with all their extra value features Taylor Forge Fittings cost no more than other makes.

• You'll find the complete story in our big Catalog 401—216 pages of usable information and valuable engineering data. Write for it today.

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General Offices & Works: Chicago, P. O. Box 485 • New York Office: 50 Church St.
Philadelphia Office: Broad Street Station Bldg.

OTHER EXTRA VALUE FEATURES

In addition to the features described opposite, WeldELLS have the following advantages which are combined in no other welding fitting:

1. Seamless—greater strength and uniformity.

2. Tangents—keep weld away from zone of highest stress—simplify lining up.

3. Precision quarter-marked ends—simplify layout and help insure accuracy.

4. Permanent and complete identification marking*—saves time and eliminates errors in shop and field.

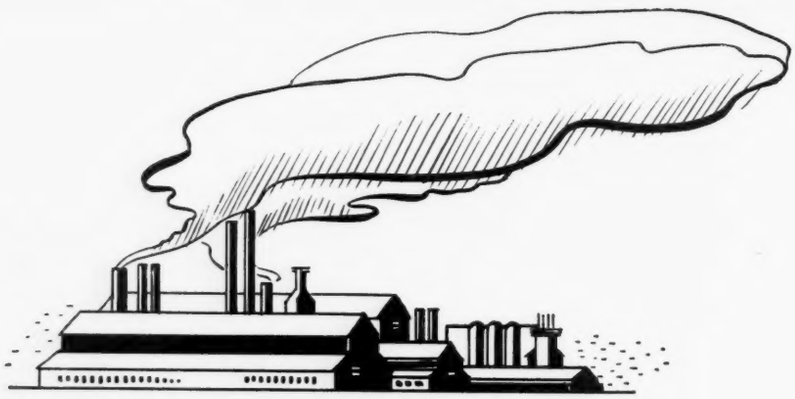
5. Selective reinforcement—provides uniform strength.

6. Wall Thickness never less than specification minimum—assures full strength and long life.

7. Machine tool beveled ends—provides best welding surface and accurate bevel and land.

8. The most complete line of Welding Fittings and Forged Steel Flanges in the World—insures complete service and undivided responsibility.

*Since the marking is pressed into the metal before forming, and since the manufacture of the fittings is carried out at a forging temperature, each in effect receives a heat treatment after the operation. The indentations have no sharp corners or edges and the marking has no effect on the strength of the fitting.



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WITH G-E WIRING MATERIALS

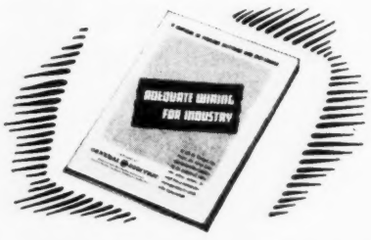
DISTRIBUTORS IN ALL PARTS OF THE COUNTRY

Avoid costly wiring system breakdowns by using G-E conduit wire and cable and wiring devices. G-E wiring materials all have uniform high quality and will give long, dependable service. They are ideal for new wiring and for modernization and maintenance work. The line is complete.

Free Wiring Handbook

To check the wiring in your plant for efficiency obtain a free copy of the handbook General Electric published recently called "Adequate Wiring For Industry." It outlines modern industrial wiring practices which can be adopted in all plants.

For further information about G-E wiring materials and for a copy of the handbook see the nearest G-E Merchandise Distributor or mail the coupon.



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General Electric Company, Section CDW1909
Appliance and Merchandise Dept.
Bridgeport, Conn.

Sirs: Please send me free a copy of "Adequate Wiring for Industry" with information about G-E Wiring Materials.

Name .....

Address .....

City ..... State .....

GENERAL ELECTRIC

FPC Waives Industrial Power Jurisdiction

The Federal Power Commission announced recently its transmittal of letters to the International Paper Company (Southern Kraft Div), Mobile, Alabama, and the Masonite Corp, Laurel, Mississippi, advising that the interconnections of International's Moss Point, Mississippi, power plant and Masonite's Laurel, Mississippi, power plant with facilities of the Mississippi Power Co. for the purpose of supplying the latter with surplus power capacity during the period of the emergency would not subject the two industrial firms to the jurisdiction of the Commission.

The actions announced are the first taken by the Commission in the present emergency under authority conferred by Section 202(d) of the Federal Power Act, which states, in part:

"During the continuance of any emergency requiring immediate action, any person engaged in the transmission or sale of electric energy and not otherwise subject to the jurisdiction of the Commission may make such temporary connections with any public utility subject to the jurisdiction of the Commission or may construct such temporary facilities for the transmission of electric energy in interstate commerce as may be necessary or appropriate to meet such emergency, and shall not become subject to the jurisdiction of the Commission by reason of such temporary connection or temporary construction." A power emergency in the Southeastern area was declared by the Commission on June 27. The exemptions granted will make available to the Mississippi Power Co. approximately 1,000 kw of surplus capacity from International Paper's Moss Point plant and certain excess capacity from 15,000 kw of generating capacity being installed by the Masonite Corp to supply its own requirements at Laurel, Mississippi.

TVA Will Operate Alcoa Hydro Plants

The Tennessee Valley Authority is to operate the 5-dam hydroelectric system of the Aluminum Company of America on the Little Tennessee River, it was disclosed recently in Washington, with the signing of a contract between the TVA and the Aluminum Company. TVA will not assume ownership of the company's plants, but will direct and control their operation.

SAVE *Hours* IN ASSEMBLY

OCKET WELDING FITTINGS

W-S Socket Welding Fittings, exceptionally strong and durable, have deeper sockets with smooth, correctly proportioned walls conforming to tentative A.S.A. standards.

SCREW END FITTINGS

W-S Screw End Fittings have longer bands extending well beyond the last thread —providing added strength and durability.

Both types of W-S Forged Steel Fittings are available in carbon steel and alloy steels. Send for Bulletin A-3; it gives all the facts — pressure ratings, sizes and prices. Write today.

In times like these when man-hours are at a premium and high working speed is all-essential to national emergency, W-S Socket Welding Fittings are vitally important.

In close quarters, tedious, complicated piping layouts can be easily installed with great speed and accuracy when W-S Socket Welding Fittings are used.

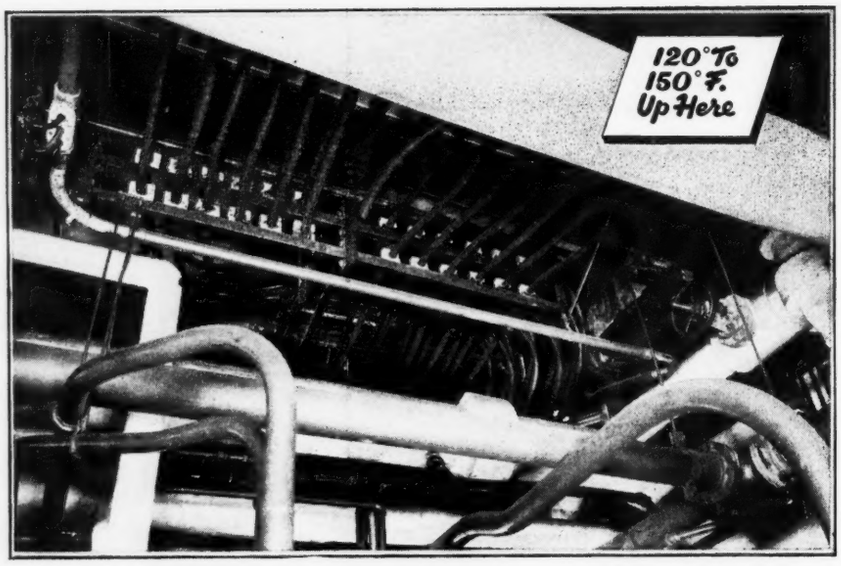
Besides saving hours of time, trouble and money in assembly, W-S Socket Welding Fittings bring assurance of long periods of trouble-free service.

The next time you order fittings, specify W-S Socket Welding Fittings.

THE WATSON-STILLMAN CO. ROSELLE, NEW JERSEY

394

WATSON-STILLMAN



STEAM LINES + WIRING = T-R-O-U-B-L-E!

Here's a nest of potential wire failures cooking up future trouble in the insulation-destroying heat of 120° to 150° F. — vital power, control and lighting circuits that are bringing shutdowns and lost production closer every day *because their insulation can't take heat!*

In an installation like this, where circuits had to be run between the steam lines and ceiling, continuous high ambient temperatures combine with conductor heating caused by production overloads to ruin anything but *genuinely heatproof, permanent insulation.* Under such heat, insulation having low temperature operating limits begins to go as soon as it is installed. It dries out, gets brittle, cracks; then moisture enters and you have a rewiring job that may tie your plant in knots.

1. Rockbestos A.V.C. Boiler Room and Lighting Wire
2. Rockbestos A.V.C. Power Cable
3. Rockbestos All-Asbestos Power and Rheostat Cable

Numbers 1 and 2, Underwriters' and N. E. Code — Type AVA, max. operating temperature 230°F., number 3, Type AI, max. operating temperature 257°F.

Another horrible example we saw a few months ago was in a steam tunnel running from a factory power plant to the shops. It was jammed with steam lines, watchman, telephone and fire alarm systems, along with 13 – No. 1/0 AC lighting circuits, 16 – 500,000CM DC power circuits and 22 – 500,000CM low voltage AC power circuits. Temperatures of 110° to 130° F. had dried them out so badly that an arc would have burned the tinder-dry insulation and crippled operations. It could have been rewired weekends with *heatproof, fireproof, permanently insulated* Rockbestos, but they were "too busy" — now they're working full time and are hoping that it won't blow.

These two examples illustrate the need for *permanent insulation* wherever wire is exposed to severe operating conditions and the necessity for anticipating your requirements. Send for a catalog and samples. Rockbestos Products Corporation, 815 Nicoll St., New Haven, Conn.

Anticipate Your Requirements!

New York Buffalo Cleveland Detroit Chicago
Pittsburgh St. Louis Los Angeles San Francisco Portland, Ore. Seattle

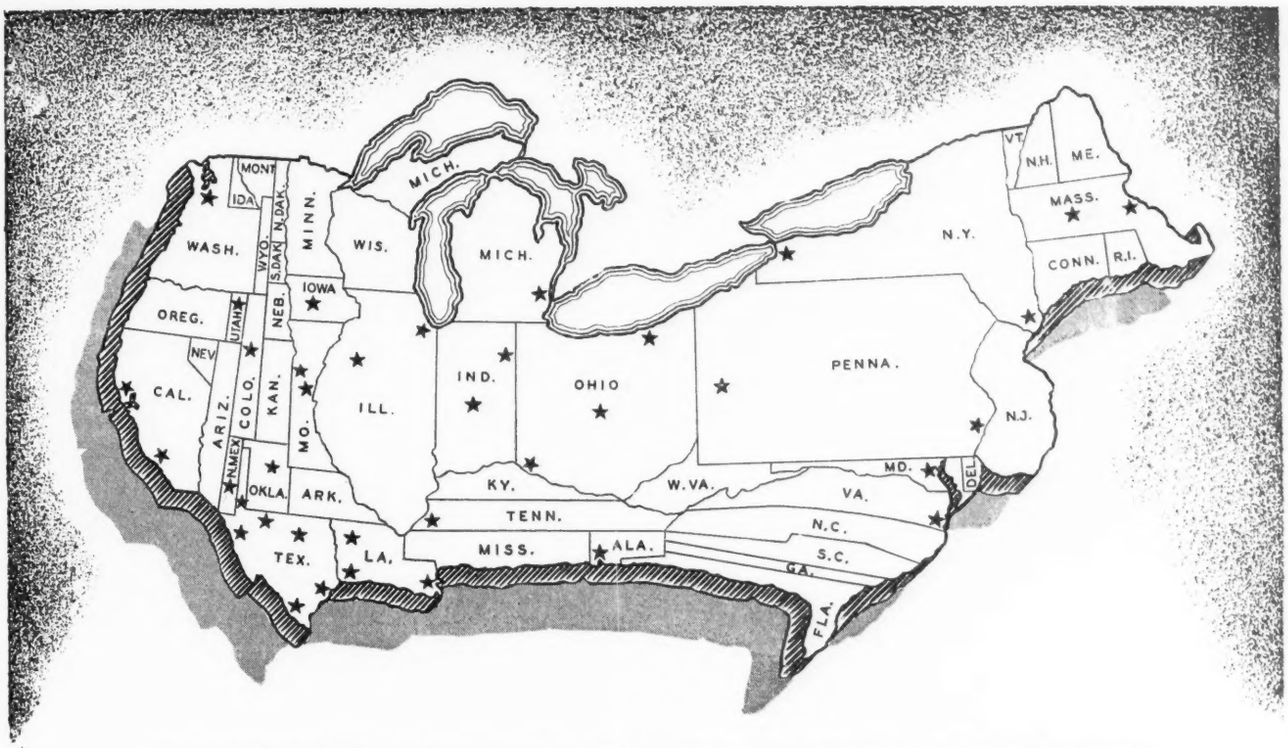
Rockbestos A.V.C. Motor Lead and Apparatus Cable – Underwriters' and Nat. Electrical Code Type AVA – one of 113 different permanently insulated wires.

and will integrate them with its own extensive system of dams in such a way as to obtain the maximum public usefulness of the water in the entire Tennessee River watershed.

Execution of the detailed agreement between Aluminum Company of American and Tennessee Valley Authority clears the way for the immediate development of the Fontana hydroelectric project on the Little Tennessee River in western North Carolina. A study of all problems involved in constructing and operating the Fontana project has convinced Aluminum Company of America that at this time, when national defense is of paramount importance, development of this great storage reservoir located in such a strategic position in the Tennessee Valley system can best be done by the Tennessee Valley Authority. The company is, accordingly, turning the property over to the Tennessee Valley Authority without cash compensation. The company will, however, receive the benefits which will accrue to its two downstream hydroelectric properties at Cheoah, North Carolina, and Calderwood, Tennessee, by reason of the construction and operation of Fontana dam.

In addition to turning over the Fontana site and all engineering data to the Tennessee Valley Authority, the Aluminum Company of America is agreeing to permit Tennessee Valley Authority to control storage and release of water in all the company's developed water powers in the Little Tennessee Valley. This will make possible the integrated operation of the water powers of the Aluminum Company of America and the Tennessee Valley Authority, including the Fontana project, and will result in the maximum production of electric energy from available water power in this locality.

The properties of the Aluminum Company of America, which will be integrated with those of Tennessee Valley Authority under this arrangement, are three large hydroelectric developments at Cheoah, Calderwood and Santeetlah, as well as one project nearing completion at Glenville, N. C., and another at Nantahala, N. C., which will be completed about July 1, 1942. Power which the Aluminum Company of America will obtain under future operation of these properties will be used for the production of aluminum at Alcoa, Tennessee, where more than 200,000,000 lb of metal is now being made annually and where plants are under construction for the production of an additional 100,000,000 lb per year.



MOST BOILERS ARE NEAR B&W TUBE DISTRIBUTORS

No, the map is not distorted. The size of each state is drawn in proportion to the horsepower installed in the state. Note how B&W Distributors in thirty-three important cities are strategically located to keep ample stocks of B&W Quality Seamless Steel Boiler Tubes within twenty-four hour trucking distance for immediate delivery *when*ever and *where*ever needed.

B&W BOILER TUBE DISTRIBUTORS

ALABAMA	Mobile—Marine Specialty Co., 57 No. Water St.
CALIFORNIA	Los Angeles—A. M. Castle & Co., 2300 E. 55th St. San Francisco—A. M. Castle & Co., 800 Indiana St.
COLORADO	Denver—Mine & Smelter Supply Co., 1422 17th St.
ILLINOIS	Chicago—A. M. Castle & Co., 1132-52 Blackhawk St. Peoria—Hagerty Brothers, 923-927 S. Washington St.
INDIANA	Fort Wayne, National Mill Supply Co., 207-13 E. Columbia St. Indianapolis—W. J. Holliday & Company
IOWA	Des Moines, Globe Mach. & Sup. Co., 205-11 W. Court Ave.
LOUISIANA	Lake Charles, Murray-Brooks Hardware Company, Ltd. New Orleans—C. T. Patterson Co., 800 So. Peters St. Shreveport—Bethlehem Supply Company
MARYLAND	Baltimore, John McKenzie & Co., Key Hway. & Boyle St.
MASSACHUSETTS	Boston—Brown-Wales Company, 493 C St. Holyoke—Massachusetts Supply Corp.
MICHIGAN	Detroit—Service Steel Co., 1435 Franklin St.
MISSOURI	Kansas City—Langdon Supply Co., 1317 Union Ave. St. Louis—Sligo Iron Store Co., 1301-1403 No. 6th St.
NEW MEXICO	Hobbs—Continental Supply Co.
NEW YORK	Buffalo—Service Steel Company New York—John B. Astell & Co., Inc., 90 W. Broadway
OHIO	Cincinnati—Williams & Co., Inc., 1921-1927 Dunlap St. Cleveland—Williams & Co., Inc., 3700-16 Perkins Ave. Columbus—The Ross-Willoughby Co., 269 W. Spring St.
OKLAHOMA	Tulsa—W. C. Norris Mfg. Co., Inc., P. O. Box 1188
PENNSYLVANIA	Philadelphia, Horace T. Potts Co., E. Erie Ave. and D St. Pittsburgh, Williams & Co., Inc., 901-37 Penna. Ave., N. S.
TENNESSEE	Memphis—J. E. Dilworth Co.
TEXAS	Amarillo—Clowe & Cowan, Inc. Dallas, Briggs-Weaver Machinery Co., 309 No. Market St. Dallas—Continental Supply Co., Continental Bldg. El Paso—Mine & Smelter Supply Co. Houston, Houston Oil Field Material Co., 1524 Maury St. Lubbock—Clowe & Cowan, Inc. Wichita Falls—The Bradford Supply Company
UTAH	Salt Lake City, Mine & Smelter Supply Co., 121 W. 2nd South St.
VIRGINIA	Norfolk, Empire Machinery & Supply Corp., 409 Water St.
WASHINGTON	Seattle—A. M. Castle & Co., 32 W. Connecticut St.

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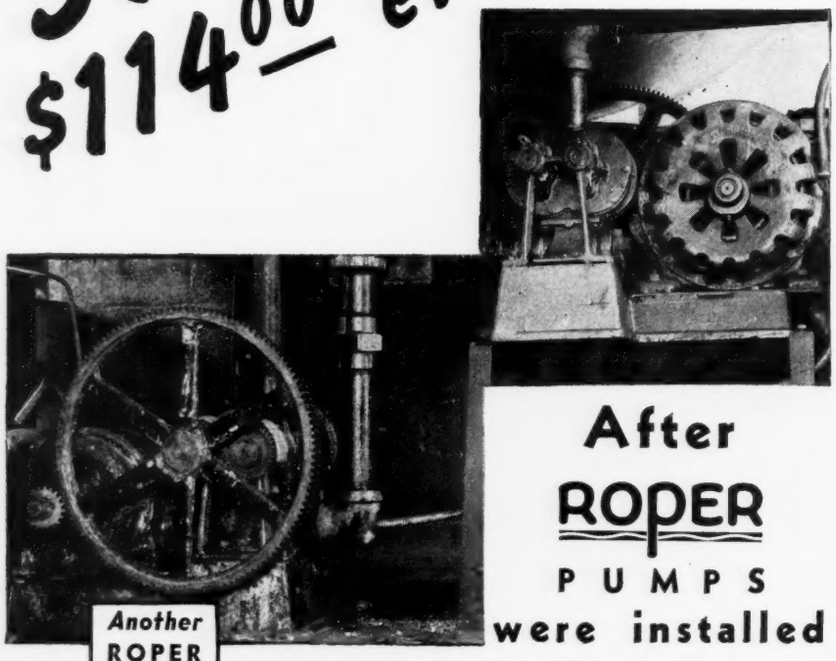

Another ROPER Case History

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A manufacturing plant pumping a heavy material . . . operating 5 pumps . . . average life of pumping heads, 16 hours at a cost of $46.65 per head or $69.95 every 24 hours. Cost of replacements on 5 pumps every 24 hours $349.75 or $116.50 every eight-hour day . . . cost per month $2330.00.

The problem was put up to Roper engineers . . . result 5 Roper Rotary Pumps installed. Average life 13 months without repairs instead of 16 hours. Savings to customer in 13 months' time $30,290.00 less $600, the cost of 5 new Ropers, or a net saving of $29,690.00.

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GEO. D. ROPER CORP.
ROCKFORD, ILL.

ROPER *Rotary* PUMPS

When Congress provides the necessary funds, the TVA will construct the dam about 450 ft high which will require almost 3,000,000 cu yds of concrete—three times as much as used in Norris Dam. It will provide approximately 1,500,000 acre-feet of flood storage and will add approximately 200,000 kw of installed capacity to the TVA system, which now totals 1,050,000 kw, and is scheduled to increase to nearly 1,600,000 kw by the end of 1942; with Fontana to total 2,200,000 kw in 1944. Cost of the dam is estimated at about $50,000,000. Request for funds for the beginning of construction will be made at once; the project has received the approval of the Office of Production Management as a defense necessity.

Fontana is a strategic dam site, since it is located above two of the Aluminum Company dams and above all but one of the nine main-river dams of the Authority, six of which are already completed and three under construction. It is expected that Fontana dam can be in partial use by 1943 to provide storage that will substantially increase TVA and Alcoa power capacity in the downstream power plants, thus relieving the great need for defense power in 1943. It is estimated that the structure itself can be completed in 30 to 36 months, when the full amount of power capacity will become available.

Secondary Networks for Industrial Plants

Design of electric power distribution systems for industrial plants will always constitute individualized problems. There is little hope that any particular form of distribution system will be applicable to all industrial plants because processes of manufacture and arrangement of buildings differ widely depending on circumstances. There are, however, certain fundamental advantages to the network system of distribution which justify a much wider use than it has found, was suggested in a paper by C A Powel and H G Barnett, and presented at the American Institute of Electrical Engineers Convention. By far the greater part of factory distribution is still of the radial type and the network system must compete with the radial system in economy, reliability and flexibility.

It is generally found necessary in modern manufacturing methods to change tool machinery and processes around in the factory from time to time to meet market condition, but it

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6—Seals bearings against entrance of dirt, water, etc.

Call in the Shell man today. Give him the toughest bearing lubrication job you've got. Watch him lick it.

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THE advantages of Enco Patented Streamlined Cross Flow Baffles have been so definitely established that all water tube boilers, whether new or old, should be equipped with them as a first step to better steam plant efficiency.

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Streamlined to avoid eddy currents and eliminate dead gas pockets that collect soot and fly ash. They save live steam because soot blowers work less often and more effectively.

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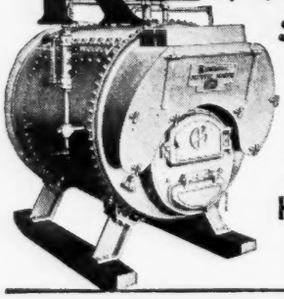

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•
Distributors Everywhere

is also true that such changes cannot be of a radical nature as the manufacturing possibilities are limited by the type and size of the building. It is, therefore, advisable in designing the distribution system to make the power available at a number of points conveniently spaced throughout the factory building without too much regard to the detailed location of the individual tools.

Network Power

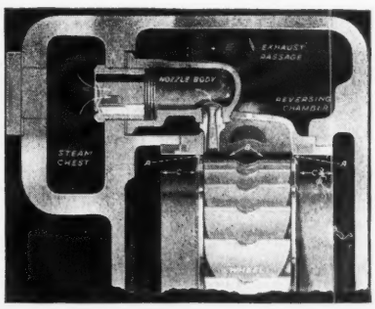
The network is well adapted to supplying power to such points, and where the total load is 500 kva or more a network, either a distributed or spot network, will frequently be justified. As the total load increases the network becomes more decisively economical.

Network systems may be divided into spot-networks and distributed networks. A spot-network consists of a bus supplied through two or more network transformers and protectors over two or more primary feeders. It may be used in the smaller plants or large commercial buildings where the demand is relatively light and distances short. The distributed network on the other hand comprises a secondary grid, the junction points of which are supplied through network transformers and protectors from two or more primary feeders. There is practically no limit to the load that can be carried on such a grid, and spot-networks grow into conventional networks as the load increases.

Definite rules regarding the number of supply points and secondary ties that should be included in factory networks, nor the best size of copper to use cannot be made. This will depend on the load density and arrangement of the manufacturing aisles in the factory buildings. It can be said, however, that when high current-carrying capacity is required in the secondary mains it is preferable to limit the size of conductor and use two or more smaller conductors in parallel instead of a single large one. For example, two 0000 conductors in parallel provide more carrying capacity than a 500,000-cm conductor and also provide better voltage regulation for a given current at power factors usually prevailing in distribution systems. Furthermore, in case of a fault in one of these parallel cables, the limiters will isolate it without breaking the network.

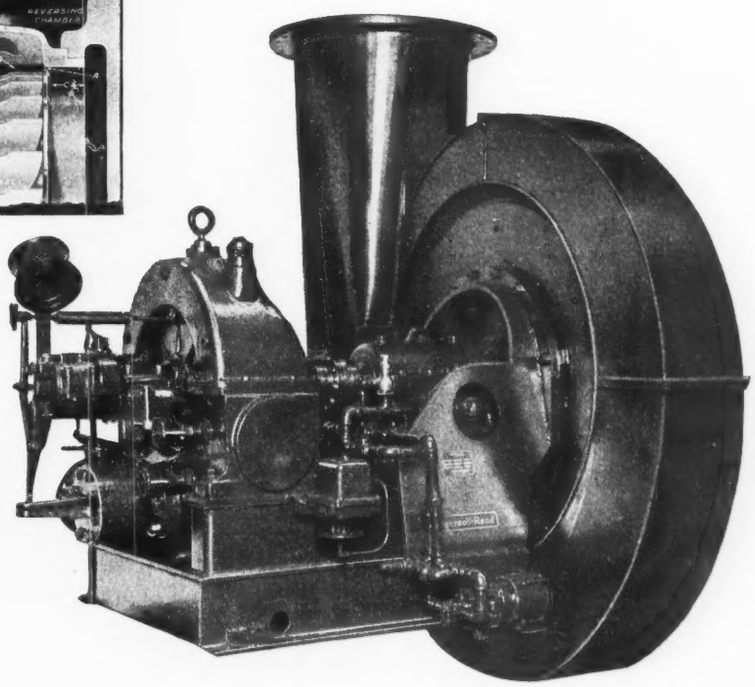
The ease with which increasing loads or rearrangement of existing loads in the plant can be taken care of is one of the outstanding advantages of the network system. A transformer can be added at a junction point of the grid

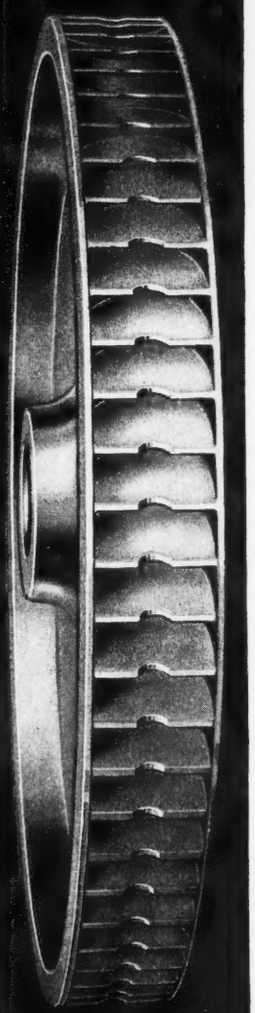
TERRY



ABOVE:
Terry Wheel Clearances. A-Rim Clearance. B-Large Blade Clearance. C-Side Clearance (about one inch)

AT RIGHT:
Typical Terry Solid Wheel Turbine direct connected to a blower.





THE BLADES ARE DOUBLE RIM PROTECTED
IN THE TERRY SOLID WHEEL TURBINE

In the Terry Turbine the blades have large clearances and are further protected by the projecting rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the radial clearance became reduced.

End play can do no damage to the blading as the side clearance is very large (about one inch). There is no end thrust since the steam enters and leaves the wheel in a direction at right angles to the shaft.

The Terry solid wheel turbine is described in our Bulletin S-116. A request on your business letterhead will bring a copy.

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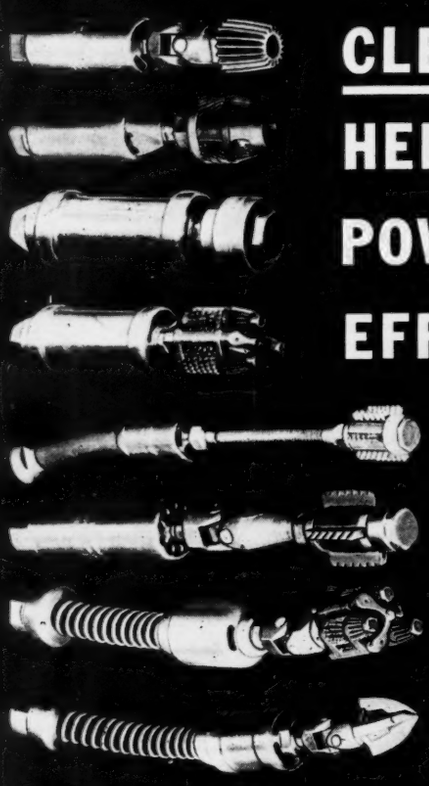
THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.



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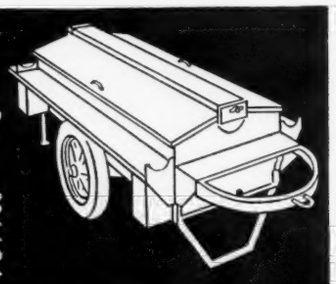

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at any time without interruption of service. The relatively small self-contained transformer unit with the network protector mounted on it require very little space.

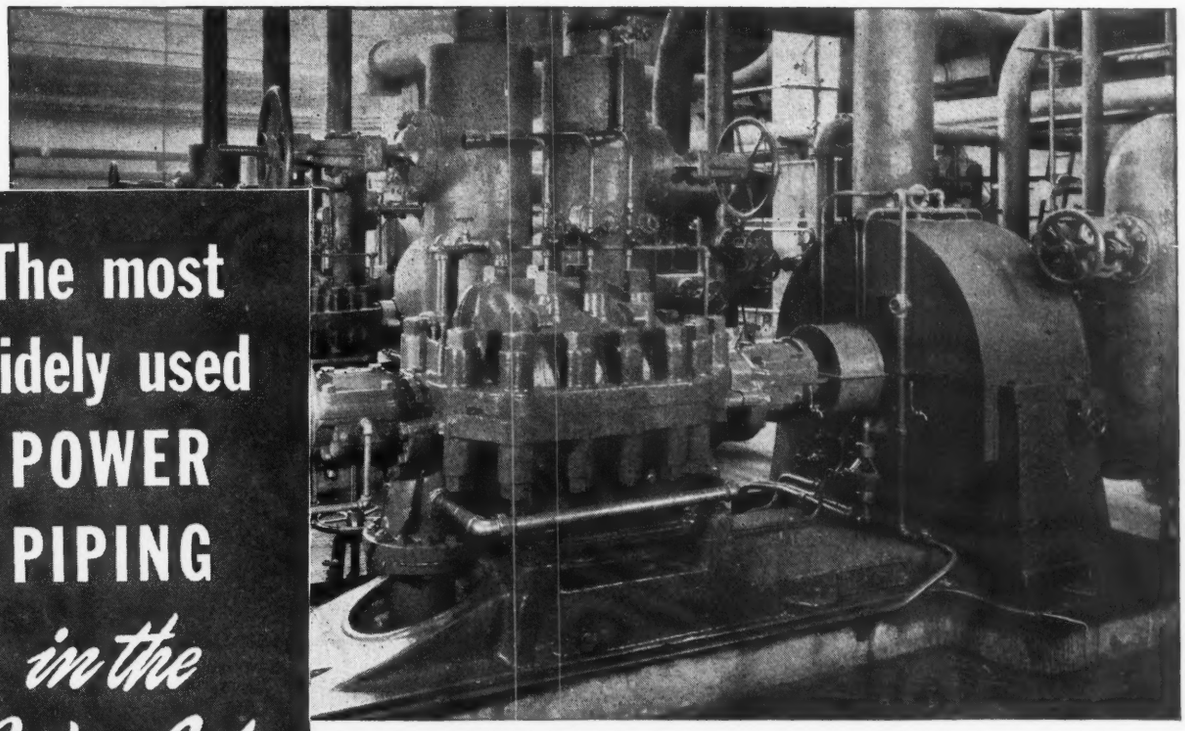
Further advantages of the system are reliability, good voltage regulation, and high economy. Reliability is improved because the grid is supplied from all the feeders supplying the factory and through all the transformers. Loss of a feeder or transformer would, therefore, pass unnoticed as far as factory operations are concerned. The regulation is better and disturbances due to starting motors are less because of the multiplicity of paths for the current.

The quality of service, that is, reliability and voltage regulation, rendered by the secondary network is better than that provided by any other alternating-current distribution system. Whether the network is economical in a particular case depends on the degree of reliability required, amount of flexibility needed to meet load growth or change.

Radial System

Whenever it is necessary to provide greater reliability than can be obtained from a simple radial system the network will always be economical, particularly for relatively large loads. To get improved reliability in a radial distribution system it is necessary to use duplicate feeders, manual or automatic throw-over switches or breaker, load transfer switches, sectionalizing switches or fuses, or other schemes for reducing the duration of outages. For faults on a primary feeder or in a transformer even these special radial schemes do no more than reduce the outage duration to a momentary interruption of service, which in many factories may not be permissible. Faults in main secondary circuits will interrupt service to all the load on that circuit until the fault can be repaired. The secondary network eliminates outages due to primary faults and most secondary faults will not interrupt service.

Flexibility of the secondary network is an economic advantage. Changes to provide for load growth or changes of load concentration from one part of a plant to another usually can be made by simply installing or moving transformers to meet new load conditions. In the radial scheme any changes in load may necessitate not only changing transformer capacity but also changing a considerable amount of secondary circuits. Since changes in processes and machines frequently are made in industrial plants, this characteristic of the network system will represent a large saving in many cases.



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. . . because it has proved its superiority in high pressure and high temperature service

MORE far-sighted engineers and industrial power experts prefer to work with NATIONAL Seamless than any other pipe. No other pipe has been able to offer a higher degree of safety and workability, or greater length of service in the presence of the new high temperatures and pressures. Countless installations all over the country—many under the most severe operating conditions, are convincingly demonstrating the outstanding ability of NATIONAL Seamless. Several industrial plants have reported operating pressures as high as 2,500 psi and temperatures up to 900°F. And NATIONAL Seamless makes these new records possible.

NATIONAL Seamless has no weld—no line of potential weakness to limit safe operating pressures. Each length is a homogeneous steel cylinder pierced directly from a billet of highest quality steel. Since only sound and flawless steel can successfully withstand this piercing method, this is your assurance of uniform physical properties, uniform wall strength and dimensional accuracy. So, whether you're planning a new system or making repairs to an old one, NATIONAL Seamless will give you longer, safer, more economical service.

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Engineers' Books

Air and Gas Compression

AIR AND GAS COMPRESSION (1941). *By Thomas T Gill. Published by John Wiley & Sons, Inc, 440—4th Ave, New York, N. Y. 181 pages, 6 x 9 in.; 37 illustrations; 27 alignment charts; 30 tables; cloth binding. Price $3.00.*

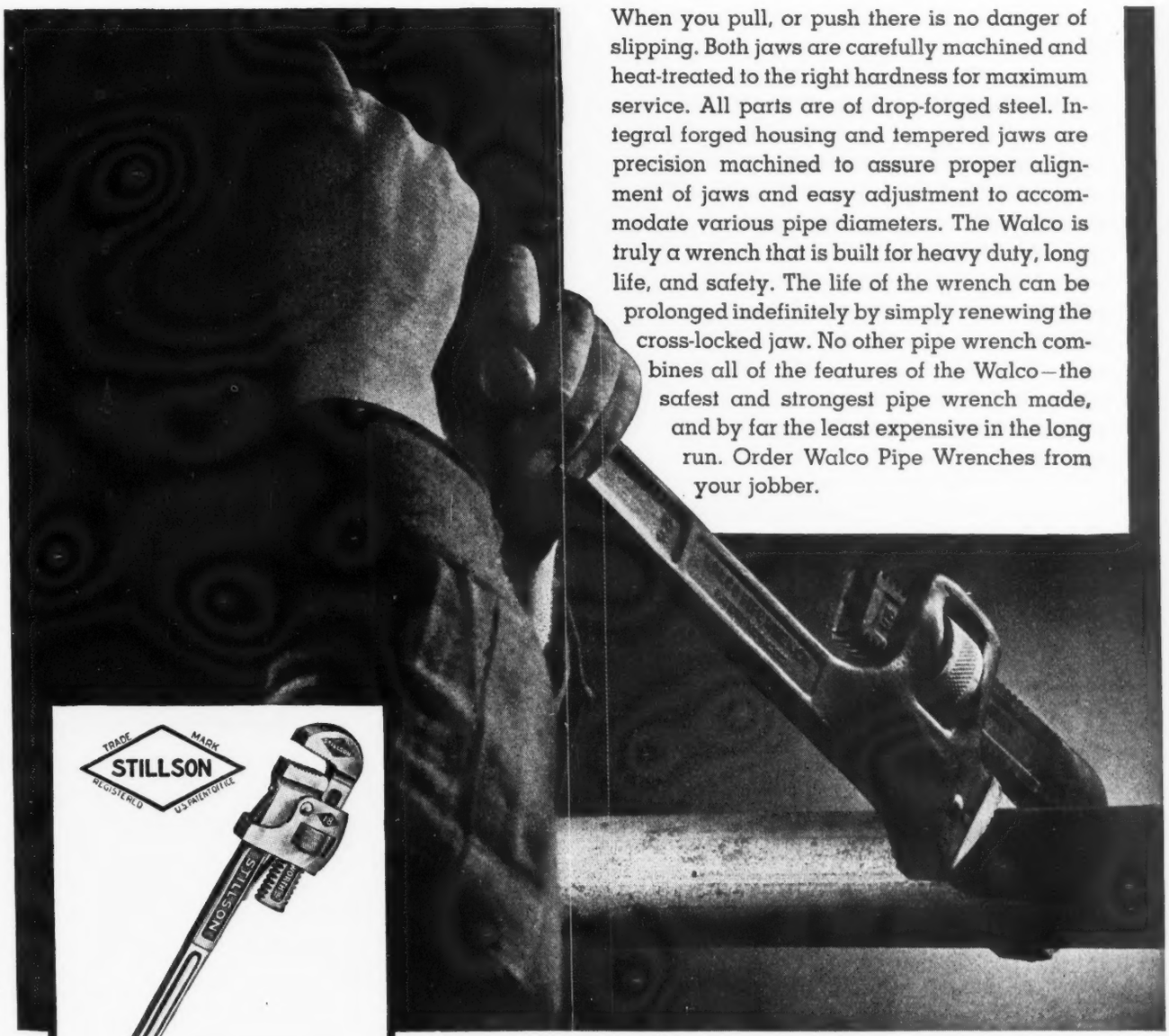
In this text book on the theory of compression the author has applied some of the results of recent researches into the properties of gases, especially in regard to compressibility, critical data and specific heat, to the solution of air- and gas-compression problems. In addition to treating the theory of compression, this book contains a chapter on the flow of gas in pipe lines and another on gas measurement by orifice meters. The chapter on gas flow in pipe lines is based on the Weymouth equation. Twelve tables are included that greatly reduce the labor required to calculate pressure drop in pipe lines. Another useful part of the work and and one involving a great deal of work is the 27 alignment charts. These cover the solution of such problems of compressor capacity and displacement, temperature rise of gas during compression, cylinder sizes, compressor unloading, equivalent length of complex pipe systems, flange taps for orifice meters, recommended sizes of orifices, etc. A very helpful part of the work is that at the end of each chapter several numerical problems are given and their solutions worked out by applying the formulas, charts and tables in the book. The author has expended a tremendous amount of effort on this text and has succeeded in producing a valuable contribution to the literature on compressed air and gas.

Pumps

PUMPS AND PUMPING—(1941). *By E Molloy, Published by Chemical Publishing Co, Inc, 234 King St, Brooklyn, N. Y. 104 pages, 5½ x 8½; 100 illustrations; cloth binding. Price $2.00.*

This book is a practical manual on the operation, installation and maintenance of pumps manufactured in England. These include reciprocating centrifugal, well and borehole, rotary and turbine pumps, air lift and submersible pumps; and pulsometer steam pumps. Attention is also given to the

GREATER SAFETY with WALCO the World's Strongest Wrench



When you pull, or push there is no danger of slipping. Both jaws are carefully machined and heat-treated to the right hardness for maximum service. All parts are of drop-forged steel. Integral forged housing and tempered jaws are precision machined to assure proper alignment of jaws and easy adjustment to accommodate various pipe diameters. The Walco is truly a wrench that is built for heavy duty, long life, and safety. The life of the wrench can be prolonged indefinitely by simply renewing the cross-locked jaw. No other pipe wrench combines all of the features of the Walco—the safest and strongest pipe wrench made, and by far the least expensive in the long run. Order Walco Pipe Wrenches from your jobber.

GENUINE STILLSON WRENCH

MADE ONLY BY WALWORTH

The genuine Stillson pipe wrench is a Walworth product. It has been used by industry for more than 70 years and is recognized the world over as the standard of quality in this type of pipe wrench. Basically unchanged it has been metallurgically modernized and the genuine Stillson, made only by Walworth, is now stronger than ever before.

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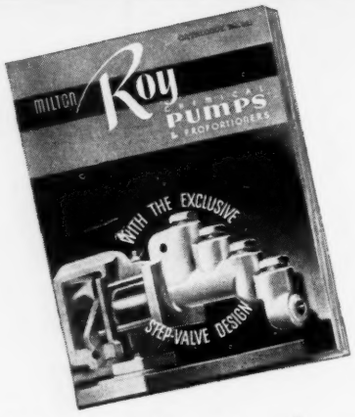

New Catalog

Contains simplified selection chart to help you choose the right pump; illustrates complete sulfite feed system to boilers; how to feed chemicals directly into boilers; shows typical installations.

This catalog fully describes the exclusive Milton Roy double-ball-check step-valve design, how it prevents air-binding and minimizes wire-drawing, why it is self-cleaning and non-clogging.

It describes an improved method for adjusting piston stroke (while running) to accurately control pump capacity; also a new single cover-plate design that makes the entire interior of the valve quickly accessible without disturbing pipe connections. It lists chemicals handled by these pumps.

You'll find all the above and other information of real value in this catalog . . . plus illustrations, specifications and details of standard Milton Roy Simplex and Duplex pumps, also Opposed-end and Quadruplex pumps built to meet special requirements.

If you need pumps for boiler-water treatments, or for accurately proportioning other chemicals, it will pay you to write for Catalog No. 941.

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We can still make prompt shipments of a number of standard size Milton Roy Pumps. Write or wire your requirements.

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1362 E. Mermaid Ave., Chestnut Hill, Phila., Pa.

Chemical Feeders and Proportioners

piping system for pumps and other features necessary to a successful pumping plant. The treatment is practical throughout, making the book of interest to anyone having to do with pumps.

Welding

LESSONS IN ARC WELDING. *Published by The Lincoln Electric Co, Cleveland, Ohio. 176 pages, 6x9, illustrated, cloth binding. Price 50 cents per copy, postpaid anywhere in U.S.A. 75 cents elsewhere. Second Edition, May 1941.*

The lessons issued in second edition, have become a standard textbook in many trade schools and other educational institutions. In concise and practical style they sum up the experience of The Lincoln Electric Company in the practical applications of welding and in the instruction of welders.

The Lincoln Welding School has been in continuous operation for 24 years. In 60 lessons this book shows the beginner, step-by-step, how to weld and why. Valuable feature is a set of questions and answers for each lesson, enabling the student to check his knowledge.

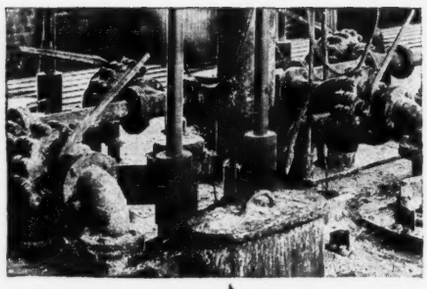
Strength of Materials

STRENGTH OF MATERIALS (1941). *By John W Breneman, Associate Professor of Engineering Mechanics, Pennsylvania State College. Published by the McGraw-Hill Book Co, 330 W 42nd St, New York, N. Y. 144 pages, line drawings, sixe 6x9 in. Price $1.50.*

Text has been written to meet the needs of the field of industrial training by providing a simplified discussion of the principles involved. It can also be used for home study, through correspondence instruction. Problems have been taken from many practical fields of engineering and design, and incorporate the fundamental principles of both mechanics and strength of materials. Mathematics above the level of trigonometry has been avoided in presenting theory and practice involved.

Subjects include the usual topics of tension and compression; riveted joints are explained and welded connections included. Beam design discussed and beam deflections considered. Design of steel and timber columns covered by the latest methods of equation and design.

Appendix contains axis designations, elements of sections, weights and areas, stresses per square inch and linear coefficients of expansion.



For quick-opening and quick-closing valve operation . . . *use*

EVERLASTING Valves, *because . . .*

A 70°-degree turn of the operating wrench completely opens or closes the Straight-lever Type of Everlasting Valve . . . and the operation is easy, because the wrench gives ample leverage.

Add to this valuable time-saving feature the many other important advantages of the Everlasting Valve . . . its drop-tight seal, its self-grinding action at each motion, its provisions against damage to disc and seat, and its "everlasting" wearing qualities . . . and you have a valve that is literally unequalled for many services on process lines, emergency shut-offs, equipment outlets, boiler blow-off, etc.

For pressures 250-lb. and less, Everlasting Valves are made of Cast Iron, Bronze Composition, or Cast Steel, and supplied in sizes 1/4 in. to 6 in. screwed and flanged. For pressures up to and including 300-lb., made of Cast Steel. For 350-lb. in the 2-in. screwed type only. and for pressures up to and including 600-lb in the 1½-in., 2-in., and 2½-in. sizes flanged. We also make a special 1-in. for 600-lb. in both flanged and screwed. Everlasting Valves of the low-pressure type available in special compositions for handling corrosive fluids.

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Jersey City, N. J.

Everlasting Valves
for everlasting protection

AT A TIME when speed is a vital necessity it is significant to note that Springfield's established policy of specializing in straight tube, sectional header boilers has been the key to a worthwhile contribution to national defense. For virtually any specified capacity, pressure, type of firing, or other condition, Springfield has a tested design which speeds up engineering, fabrication, and erection, to say nothing of assuring highly accurate predetermination of results. Already, Springfield's specialization has benefited many defense construction projects and made possible the handling of other jobs for industry at a time when production facilities are being called to deliver utmost capacity. We will be glad to show you how the Springfield Design can simplify your boiler problems. SPRINGFIELD BOILER CO., 1953 E. Capitol Ave., Springfield, Ill.

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SPRINGFIELD

STEAM GENERATING UNITS

SPRINGFIELD BOILERS

ANY SIZE
ANY FUEL
ANY PRESSURE

Read What Users Say

➡ BETTER THAN 100% RETURN!

"We have been using a FYR-FEEDER for the past six months on a 300 H.P. Heine boiler with very good results and a material saving . . . We are satisfied that our saving is better than $100.00 per week which will pay for the installation in less than a year."—*Works Manager, metal manufacturing company.*

➡ $1500.00 ANNUAL SAVING

"Your FYR-FEEDER system of burning cheap coal, installed under one of our 250 H.P. boilers and replacing an underfeed type of stoker has reduced our coal bill from $4,000.00 to $2,500.00 annually."—*Chief Engineer, beverage plant.*

➡ SOLVES LOAD PROBLEM

"The other stoker we had in couldn't handle the load. We have nothing to worry about anymore since we installed the FYR-FEEDER . . . wouldn't do without it!"—*Laundry Owner.*

SEE opposite page for facts about the FYR-FEEDER. For complete details, write AMERICAN COAL BURNER CO., 151 E. Superior St., Chicago, Ill.

-about the FYR-FEEDER *

*SEE OPPOSITE PAGE

Coal and Coke Analysis

METHODS OF ANALYSIS OF COAL AND COKE (First American Edition, 1941). *Reprinted by permission of the Controller of His Britannic Majesty's Stationery Office, from the 44th in a series of reports by the Fuel Research Board, Dept of Scientific and Industrial Research. Published by Chemical Publishing Co, Inc, Brooklyn, N. Y. 85 pages, 5½x8½ in., diagrams, charts and tables, cloth binding. Price $1.50.*

Describes methods evolved primarily for use at the British Fuel Research Station and Coal Survey Laboratories, where a high degree of accuracy is required. They are published so as to be available to others who may require this high standard, as well as to provide a record of part of the researches of the Dept of Scientific and Industrial Research. They do not differ fundamentally from the corresponding methods given in the latest specifications of the British Standards Institution, and in fact the Fuel Research organization cooperates in the preparation of these specifications.

Such differences as exist are explained by the different purpose of the British Standard specifications which is to provide reliable methods for industrial application in the buying and selling of coal and in the carrying out of performance and efficiency tests on plants consuming coal. In general, the present Fuel Research methods give more explanatory details than the specifications and certain methods are included for which there are at present no British Standard specifications.

Methods treated include: preliminary treatment of sample, determination of total moisture, proximate analysis, ultimate analysis, determination of "sulphate" and "pyritic" sulphur, nitrogen, chlorine, oxygen, phosphorus, arsenic, and carbon-dioxide. Similar ground is covered in connection with tests of coke, including also determination of calorific value, of volatile therms, and of the agglutinating value of coal. Concluding chapters cover reproducibility of analytical results, method of reporting results, and mechanical mixing of samples.

Mechanics

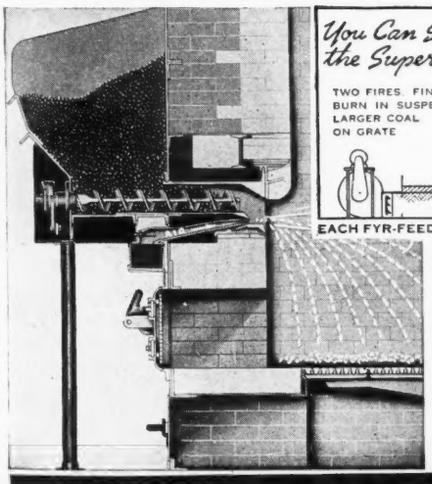
MECHANICS *By John W Breneman, Associate Professor of Engineering Mechanics, Pennsylvania State College. Published by McGraw-Hill Book Co, 330 W 42nd St, New York,*

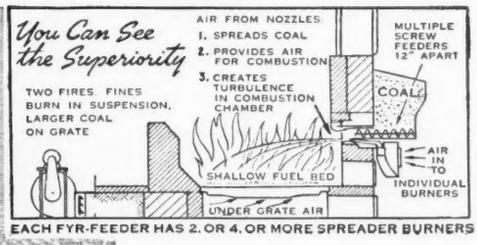
Use this-

"✓CHECK CHART for Stoker Buyers"

Fyr-Feeder MULTI-BURNER STOKERS

Features You Want:	FYR-FEEDER:
1. MODERN FIRING METHOD	✓ The FYR-FEEDER is the newest type of spreader stoker, which in turn is the latest development in coal firing equipment. Burns cheapest coal, thereby reducing coal bills. Excellent results with wet or dry coal. Users report savings up to as much as $4.00 per ton by using local screenings, yard sweepings, etc.
2. SIMPLE CONSTRUCTION	✓ The FYR-FEEDER is the simplest spreader stoker built. (See accompanying sketch.) No steam jackets, no water jackets, no high pressure fans, no furnace gases needed to dry coal before firing, no high speed moving parts in contact with coal or exposed to radiant heat of furnace. Compare FYR-FEEDER'S neat, compact, streamlined appearance with conventional bulky, exposed stoker designs.
3. DEPENDABLE PERFORMANCE	✓ Even in small FYR-FEEDER units, users get the dependability of two, four, or more, independent burners. No trouble with clogging due to wet or damp coal. Virtually immune to damage from any source.
4. HIGH FIRING EFFICIENCY	✓ Ability to follow fluctuating loads closely . . . use of a thin fire bed . . . excellent turbulence in furnace, all make for high average efficiency.
5. LOW OPERATING COST	✓ Power requirements for the FYR-FEEDER are very low. Little attention or supervision is required. Fireman's work is made easy because operation is automatic.
6. QUALITY CONSTRUCTION	✓ Fine grained semi-steel castings, precision cut gears, modern streamlined steel plate work all contribute to a standard of quality second to none. Assembly includes finest motors, fans, controls, etc., obtainable.
7. RELIABLE ENGINEERING	✓ More than 23 years of successful combustion engineering experience in engineering and building thousands of overfeed stokers stand back of the FYR-FEEDER. A drawing is made for each installation by our Engineering Department.
8. MAXIMUM RETURN ON INVESTMENT	✓ The FYR-FEEDER has repeatedly demonstrated its ability to pay the highest return available. We will be glad to submit a proposal on your requirements. Write.




You Can See the Superiority
AIR FROM NOZZLES
1. SPREADS COAL
2. PROVIDES AIR FOR COMBUSTION
3. CREATES TURBULENCE IN COMBUSTION CHAMBER
MULTIPLE SCREW FEEDERS 12" APART
TWO FIRES. FINES BURN IN SUSPENSION. LARGER COAL ON GRATE
COAL
AIR IN TO INDIVIDUAL BURNERS
SHALLOW FUEL BED
UNDER GRATE AIR

EACH FYR-FEEDER HAS 2, OR 4, OR MORE SPREADER BURNERS

HERE is the stoker that is giving power plant engineers A NEW LEASE ON LIFE! Automatic . . . dependable . . . highly flexible . . . lots of overload capacity . . . easily installed at very moderate cost . . . and the best part about it is that FYR-FEEDER installations invariably pay for themselves in a very short time out of savings made by burning the cheaper grades and sizes of coal.

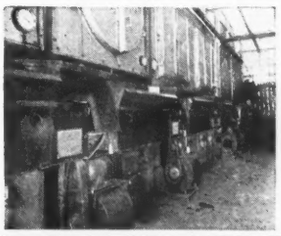
AMERICAN COAL BURNER COMPANY

FOUNDED 1918

Builders of thousands of over-feed stokers

151 E. SUPERIOR ST. CHICAGO, ILL.

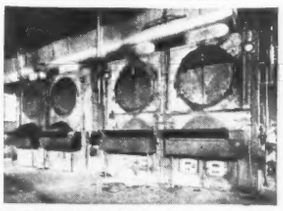
Battery of Six FYR-FEEDERS.

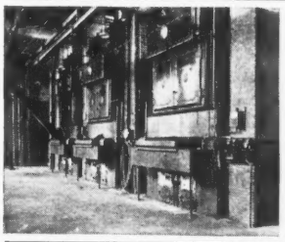


Left—Large Manufacturing Plant installs six FYR-FEEDERS. Formerly boilers were fired by underfeed stokers.

Five Repeat FYR-FEEDER Orders.

Right — Large Manufacturer buys one FYR-FEEDER Stoker. The results so good that three additional FYR-FEEDERS were purchased for the same plant and two additional FYR-FEEDERS for another plant.

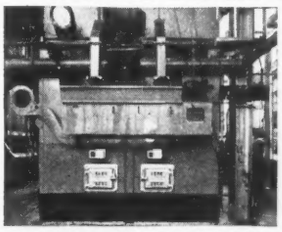




Left—Large educational institution has replaced three multiple underfeed stokers with Multi-Burner FYR-FEEDERS. Saves $7500 annually.

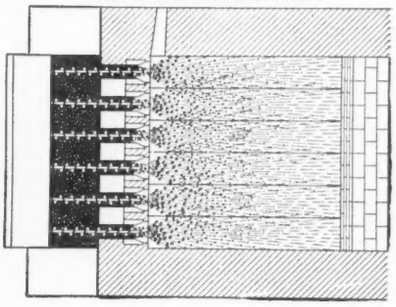
Right—Large College has replaced two Chain Grate Stokers with Multi-Burner FYR-FEEDERS which paid for themselves in a very short time.

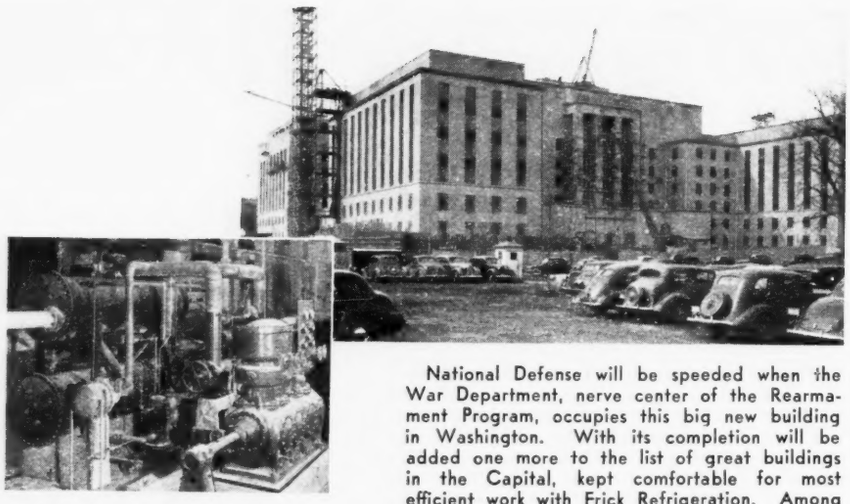
Now Burn Less and Cheaper Coal.



Left—Large Industrial Company replaces Pulverized Coal Burning with FYR-FEEDERS. Now burn less and cheaper coal. Total savings amount to many thousands of dollars each year. Photo shows repeat order installation.

Below—A Plan View of a 6-Burner FYR-FEEDER Showing Coal Distribution PATTERN.





National Defense will be speeded when the War Department, nerve center of the Rearmament Program, occupies this big new building in Washington. With its completion will be added one more to the list of great buildings in the Capital, kept comfortable for most efficient work with Frick Refrigeration. Among the many other Washington buildings Frick-equipped are those of the Dept. of Agriculture, Home Owners Loan Corp., and the Police Court — not to mention numerous stores, theatres, restaurants, etc.

Whatever your business, you can give better service and earn better profits with the aid of Frick Refrigeration. It's your most dependable choice for air conditioning, cooling drinking water, making ice, doing process work, or packing, storing, selling and serving foods and beverages. Write for details, mentioning the cooling work you wish to do.

FRICK CO., Waynesboro, Penna.

Gigantic New War Dept. Bldg. Air Conditioned with

TRADE FRICK MARK

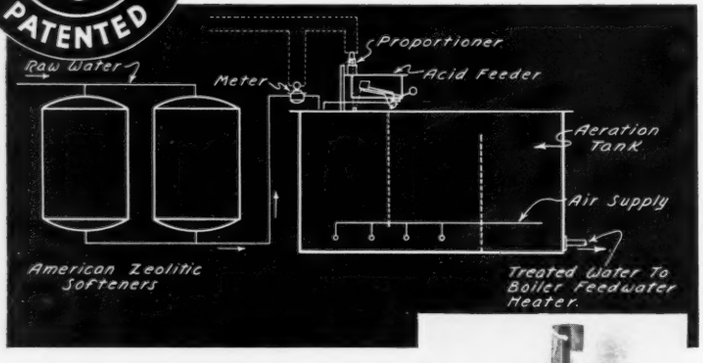
Refrigeration

AMERICAN SYSTEM W A S Co PATENTED

For Proper Sulphate-Carbonate Ratios

Use

AMERICAN SULPHURIC ACID FEEDERS



- **Lowers Alkalinity**
- **Increases Sulphates**
- **Accurate Acid Dosage assured by the famous non-clogging American Electro-Magnetic Proportioner.**
- **Accidental Overdosage of Acid prevented by automatic shut-off.**

The AMERICAN WATER SOFTENER CO.
WATER REFINING EQUIPMENT HEADQUARTERS
322 LEHIGH AVE., PHILA., PA.

N. Y. 141 pages, line drawings, formulas. Size 6x9 in. Price $1.50.

Part of the industrial series of text books, this volume is used principally in adult teaching. Deals with the basic principles of mechanics, beginning with a definition and study of the four fundamental quantities and carrying through to more complicated topics, such as curvilinear motion and rotation, moment of inertia, and work energy and power. Problems are constructed and worked out with necessary formulas and elements.

Machine Shop Practice

NEW ENCYCLOPEDIA OF MACHINE SHOP PRACTICE. *Edited by Prof G W Burnwell, Stevens Institute of Technology. Published by Wm H Wise & Co, Inc, New York City. 576 pages. Nearly 1000 illustrations. Numerous diagrams and tables. Cloth 6x9 in. Thumb indexed. Price $1.98.*

With a national need for mechanics of all grades, this book fills a great need. It is directed to and priced for the mass market. Illustrated throughout with clear sketches (mostly perspectives), and written in practical straight-forward style, this book should yield a large return on the investment to any man who uses or expects to use, metal working tools. Even the experienced machinist will find the volume of great value for reference. The beginner will find here detailed instructions for using hand tools, for operating lathes, milling machines, centerless grinders, etc.

Other subjects covered include powder metallurgy, gear cutting, heat treatment, forge and foundry work. Metals (at great length), screw cutting, gears, gear cutting, jigs and fixtures, pressing, stamping, punching, heat treatment, welding, soldering, brazing, forging, foundry work, measuring and testing, machine drawing.

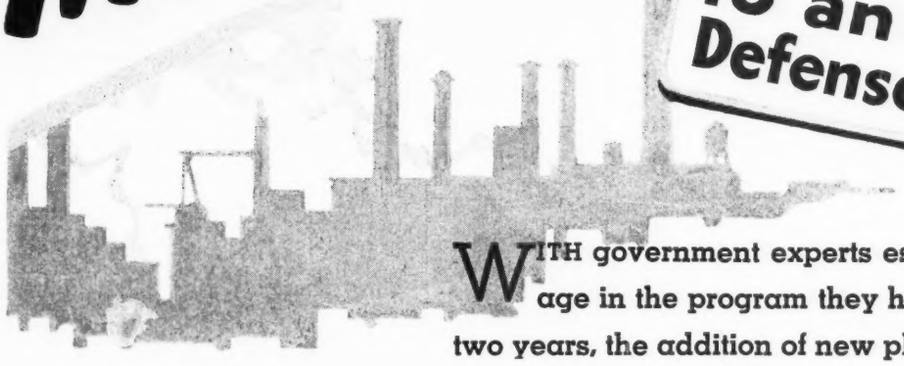
Mathematics

MATHEMATICS (1941). *By John W Breneman, Associate Professor of Engineer Mechanics, Pennsylvania State College. Published by McGraw-Hill Book Co, 330 W 42nd St, New York, N. Y. 210 pages. $1.75.*

This text, another of the industrial series, has been written expressly for providing adequate study of the subject for the person whose formal schooling in his field has not been

MORE POWER?

One Solution to an Urgent Defense Problem



WITH government experts estimating a power shortage in the program they have laid out for the next two years, the addition of new plants and the expansion of present plants seem inevitable.

COCHRANE equipment and engineering experience can assist in the expansion of power plant facilities through the increased efficiency made possible by modern feedwater conditioning, continuous boiler blowdown steam purification, efficient condensate drainage and effective boiler room instrumentation; and in adapting such equipment to present plant facilities.

Consult a Cochrane representative when planning plant expansion or when erecting a new plant.

400,000 lb./hr. Cochrane Deaerator at the plant of FLORIDA POWER CORP., St. Petersburg, Fla.

The new Cochrane 36-page Publication 3005 is a comprehensive treatise on deaeration and deaerating equipment. Flow diagrams, photographs and cross-sectional drawings simplify the story. Write for your copy today.

Cochrane Corporation

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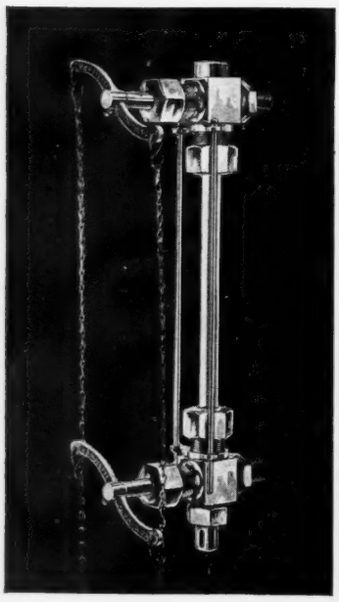
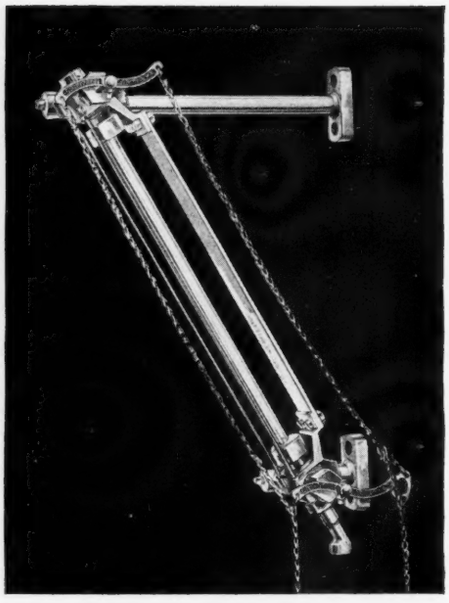


"PBH" Vertical Gauge

"PBH" Tiltview Gauge (Patented)

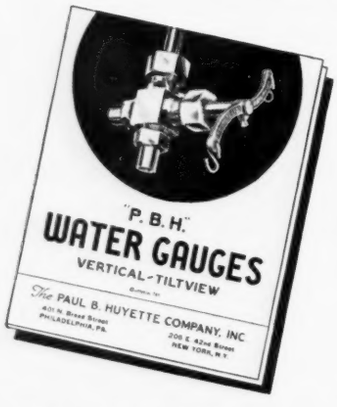


HUYETTE WATER GAUGES

DURING the past forty-five years, our activity has been devoted to designing and manufacturing a complete line of quick closing water gauge valves. The wide use of "PBH" Gauges during this period indicates that industry does appreciate quality. Our high standards of material, workmanship and inspection continue today on an ever-increasing scale.

All "PBH" valves are polished, well proportioned, of heavy bronze alloy according to A.S.M.E. Code and stamped with maximum working pressure. Glass and stem nuts are large to accommodate ample size packings, insuring steam-proof and leak-tight service.

"PBH" Tiltview Gauges are recommended for easier visibility when gauges are high above the operating floor. Tiltview offset right or left hand—at 30° inclination.



GET THIS DATA SHEET! Our new bulletin No. 471 gives complete data and specifications on all "PBH" Water Gauges. Sizes, working pressures and pipe connections are included together with complete illustrations. Your letterhead will secure you a copy—write today.

THE PAUL B. HUYETTE CO., INC.

Established 1896

405 N. BROAD ST., PHILADELPHIA, PA.

completed. It has also been written for those who lack sufficient mathematics, study of which will aid in their advancement in industrial positions. According to the author, it is particularly adaptable for those desiring to refresh their knowledge of the subject and for those who wish to add to their ability by studying at home.

Subjects include a brief review of arithmetic, fractions, algebra, including simultaneous and quadratic equations, and the use of handbook tables which have been incorporated into the appendix. Fundaments of plane geometry are covered by the use of geometrical constructions where geometrical theorems are made into practical problems. Use of trigonometry has been dealt with, and incorporates the fundamental laws solved by both natural and trigonometric functions.

The study and use of logarithms in the solution of triangles is also presented as a companion to the section on trigonometry and oblique triangles.

Mechanical Engineering

MECHANICAL ENGINEERS' HANDBOOK (Fourth Edition 1941). *Lionel S Marks, editor. Published by McGraw-Hill Book Co, 330 W 42nd Street, New York, N. Y. 4½x7 in.; 2276 pages; over 1700 illustrations, 800 tables, thumb-indexed. Price $7.00.*

Revision of engineers' handbook is not only new version of last edition but most of the sections have been completely rewritten. Contains advances in practice, theory, systematization of machine elements, material and processes and includes developments of importance during the 11 years since the third edition was published.

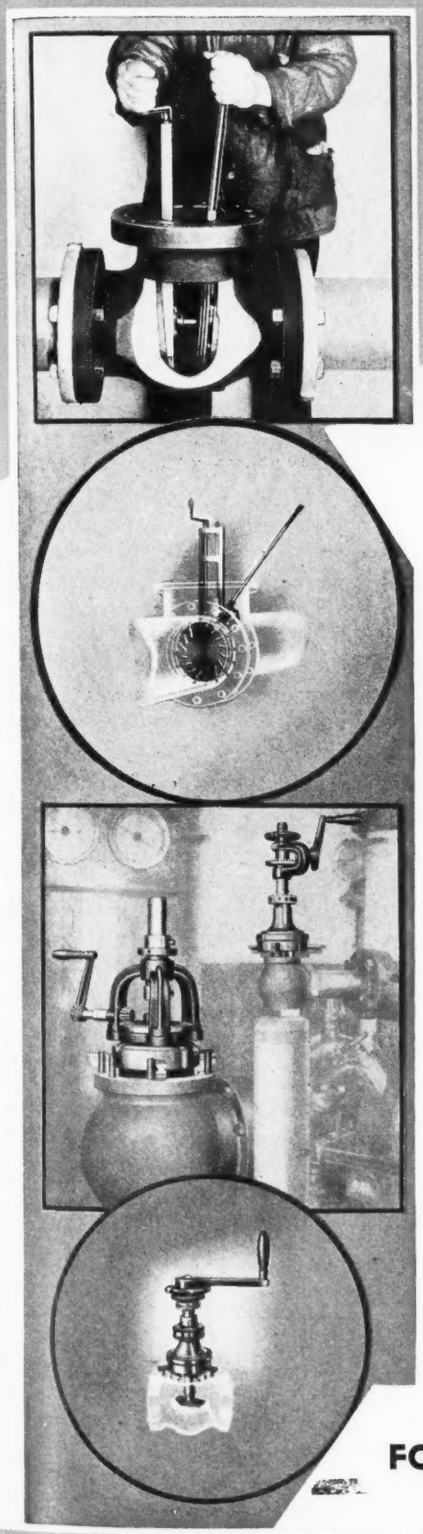
The present edition, although it contains only a few more pages than the earlier edition, has many new features. New and completely rewritten sections cover theory of models, heat, gas-vapor mixtures, heat transfer, radiant heat, mechanical properties of materials, pipe-line flexure stresses, ferrous and non-ferrous alloys, lubricants, fuels (including diesel fuels), systematization of flow of liquids through orifices and nozzles, wind pressure, sound and noise, automatic control, boilers, internal-combustion engines, packing pumps, compressors and fans.

Numerous tables of sizes, values and other data are sprinkled liberally throughout the volume, close to methods or formulas to which they apply; others are grouped in indexed sections.

Ninety engineers and scientists contributed material toward the basic in-

Fix up YOUR old VALVES

You may not be able to get replacements



"PREVENTIVE MAINTENANCE"
with
DEXTER VALVE RESEATING EQUIPMENT

puts new life . . . in old valves
eliminates waste . . .

It's a lot better to keep those old valves in operating condition than it is to have no valves to operate. You may be up against a real problem today if you discard valves and then find you can't get new ones to replace them.

Many plants are taking advantage of Dexter Valve Reseating Machines to put their old valves in good serviceable, leak-less condition. By applying "preventive maintenance" through reseating, these plants are eliminating waste and inefficiency and avoiding the chances of shut-down when maximum production 24 hours a day is the watchword throughout industry.

With the ever increasing difficulty of obtaining new valves and valve parts, it's just good business insurance to install Dexter Valve Reseating outfits to protect the performance of valves now in service.

With *continuous service* the order of the day, time out for replacements or repairs must be avoided. Existing conditions only emphasize the advantages of "preventive maintenance" with Dexter equipment:

Because:

. . . existing valves are reseated *in position* without breaking a pipe connection.

. . . time required for reseating is only a few minutes and even then the job can be done when there will be little or no service interruption.

. . . reseating is so simple that it can be done by any mechanic.

. . . the work is so accurate that valve seat and disc are absolutely tight—and the valves as good as new.

. . . a few valves *saved* pay for the entire outfit.

THE DEXTER WAY *is the* WAY
***for* TODAY . . . *Investigate* NOW!**

FOR GATE GLOBE *and* PUMP VALVES.

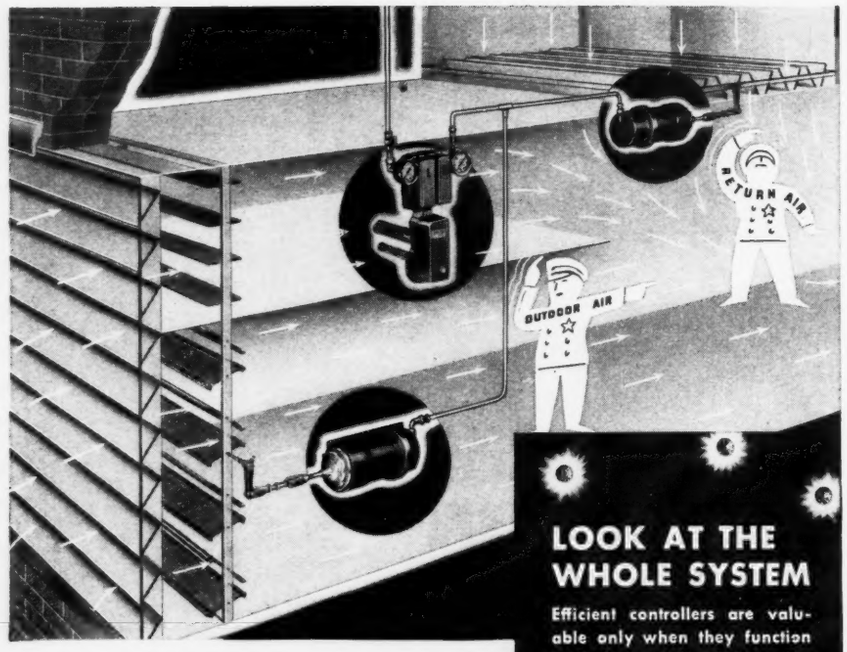
MAIL COUPON *for* COMPLETE INFORMATION

HE LEAVITT MACHINE CO., ORANGE, MASS.

Kindly send (without obligation) a copy of your catalog No. 40 describing Dexter Valve Reseating Machines

Name ..... Position .....

Company ..... Address .....

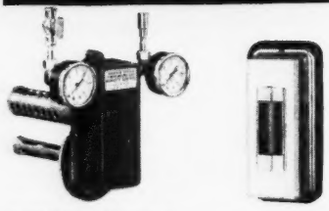


REDUCED LOAD—
MAXIMUM ECONOMY
Under Varying Outdoor
Atmospheric Conditions with
JOHNSON
Comfostat
CONTROL

Here's the answer to the problem of how to determine the proper quantity of outdoor air to bring into an air conditioning system, under all conditions! In the illustration above, a special Johnson "Comfostat", in the minimum outdoor air intake, measures the temperature and relative humidity of the outdoor air. When that combined effect is below the setting of "Point 1" of the "Comfostat", only a minimum quantity of outdoor air is admitted. As the temperature and humidity begin to rise above the setting of "Point 1", the maximum outdoor air damper gradually opens, while the return air damper closes. When the outdoor temperature and humidity have risen sufficiently to exceed the higher setting, ("Point 2"), the maximum outdoor air damper gradually closes while the return air damper opens. Minimum quantities of outdoor air when the weather is cold, maximum outdoor air during the "in-between" seasons, minimum amounts again when the outdoor air is hot and moist. Send for bulletins.

LOOK AT THE WHOLE SYSTEM

Efficient controllers are valuable only when they function perfectly in relation to the entire control installation. That's why complete control systems are important, designed, manufactured and installed by a single, nation-wide organization. Johnson engineers are ready to supply detailed information. Call them or send for literature. There is no obligation.



JOHNSON
Jeweled Movement
COMFOSTATS

The special problem shown here is just one of those that are solved by Johnson Comfostats. These controllers, available in both duct and room patterns as illustrated above, have two sensing elements. That which is affected by changes in dry bulb temperature is adjusted automatically by the element which is affected by variations in relative humidity. The ratio between the two may be set at any desired value.

JOHNSON
Automatic TEMPERATURE AND AIR CONDITIONING ***Control***

JOHNSON SERVICE COMPANY, MILWAUKEE, WISCONSIN, AND BRANCHES IN PRINCIPAL CITIES

formation in their particular field. Among these are W H Carrier, Carrier Corp; J F Barclay, U S Bureau of Mines; G A Orrok, consulting engineer; E N Fales, U S Air Corp; W M White, manager, Hydraulic Dept, Allis-Chalmers Mfg Co, and many others.

MECHANICAL ENGINEERING PRACTICE. (Third Edition, 1941). *By Charles F Shoop, Professor of Steam Engineering, University of Minnesota, and George L Tuve, Professor of Heat-Power Engineering, Case School of Applied Science. Published by McGraw-Hill Book Co, 330 W 42nd Street, New York, N. Y. 506 pages, 6x9 in., 202 charts and diagrams, 43 tables, 88 experiment report forms, cloth binding. Price, $4.00.*

More tables, charts and performance data have been included in this third edition of a text designed as a self-contained handbook on experimental mechanical engineering. The entire text has been revised to obtain the best correlation and introduction of the new material and new test-code requirements and recent instrument developments have been carefully included. Emphasis on fundamental instrumentation and test methods has been retained.

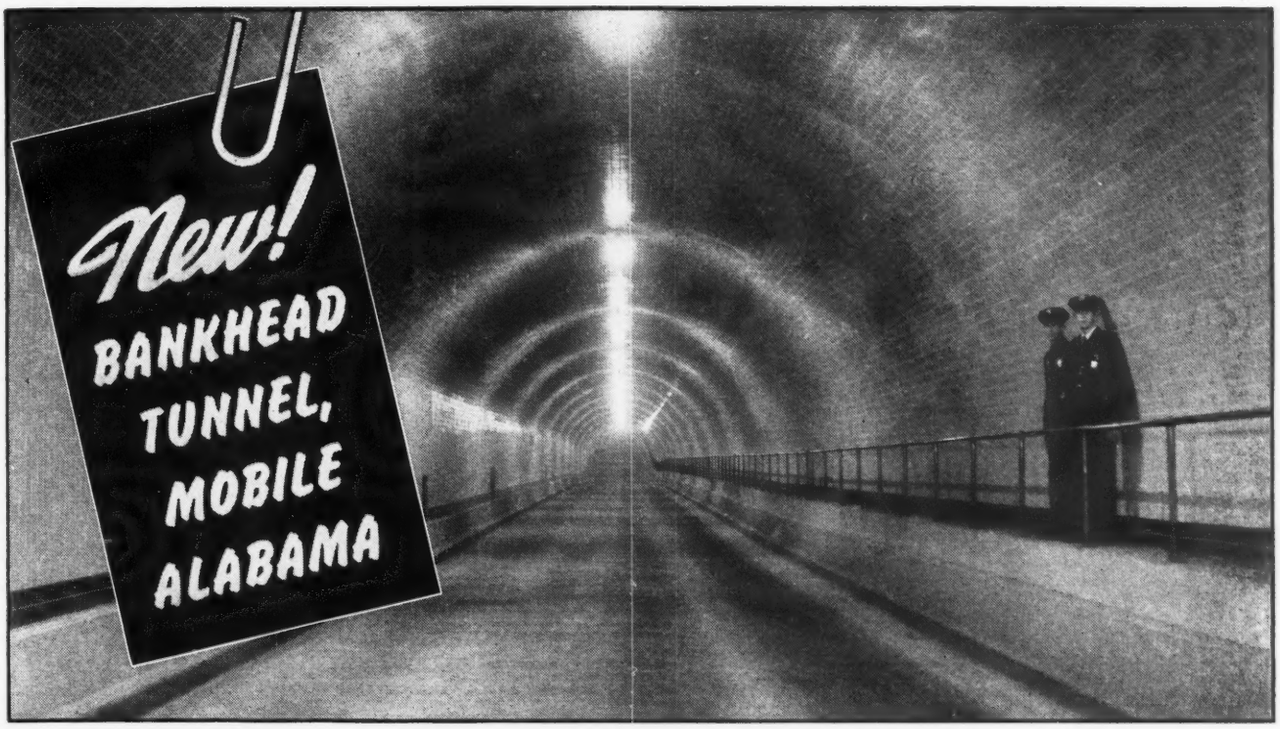
The usual work on instruments has been expanded to include such familiar items as automobile-engine tune-up, measurements by domestic gas and water meters, sampling and testing of fuel and lubricants, tests of belt drives, propeller fans, house-heating furnaces, boilers, radiators, and other common devices. Many laboratory experiments have been added in the newer fields, such as fluid mechanics, automotive and diesel engines, heat-transfer, and air conditioning.

Directories

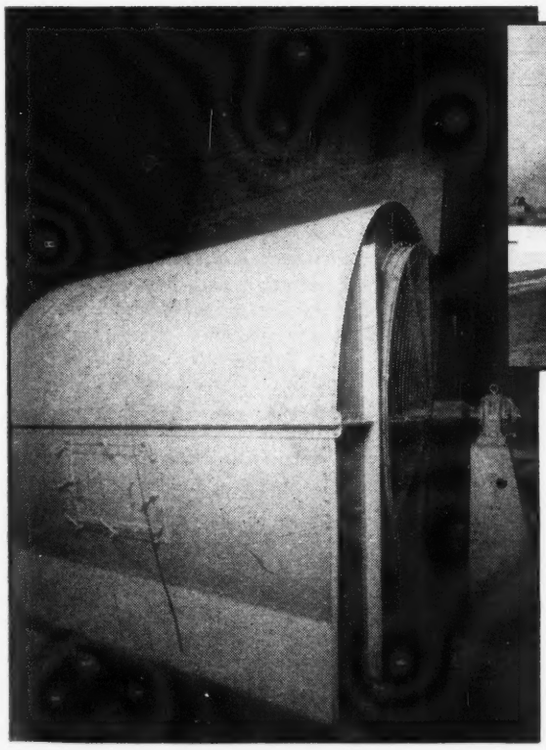
DIRECTORY OF NEW ENGLAND MANUFACTURERS, (1942). *Issued with the editorial cooperation of the New England Council. Published by Geo D Hall Company, 30 Kilby St, Boston, Mass. 756 pages, cloth bound, 8½x11 in. Price $25.00.*

This book contains listings by type of product and by brand name or trademark of industries throughout the New England states.

Geographical listings make it easy to locate sources of supply and give complete picture of the structure in any New England community. In addition to company name, each listing gives the names of all important company officials of interest to buyers and sell-



3109 ft. of CLARAGE Ventilation



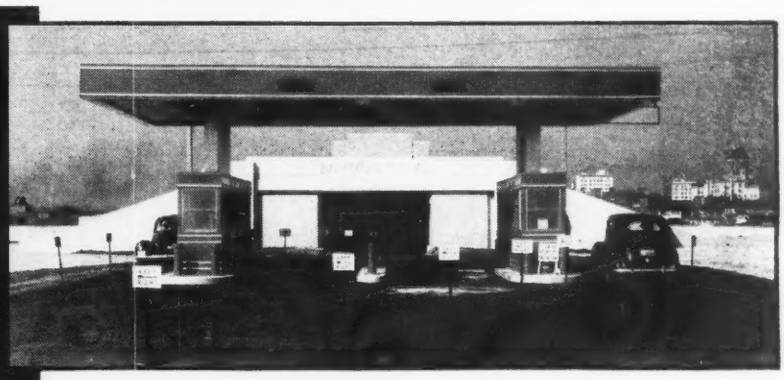


Photo above shows one of the three giant Clarage Fans which ventilate Bankhead Tunnel, capacity of each fan regulated to handle both normal and peak traffic loads.

Engineers: Wilberding & Palmer, Inc., Mobile and Washington, D.C. General Contractors: Arundel Corp., Baltimore. Ventilating Contractors: Rust Engineering Co., Pittsburgh.

An outstanding example of Southern progress! This new Bankhead Tunnel, under the Mobile River, saves 7½ miles between Mobile's business district and points north and east. It cost $4,000,000 — one of the finest vehicular tunnels in the world.

. . . *And Clarage Fans are used for its ventilation,* providing a complete air change every two minutes. Fresh air is drawn in from each entrance to the deepest point in the tunnel — then exhausted through ducts beneath the roadway level.

Wherever fans or blowers are required for any purpose IT PAYS TO USE CLARAGE, "*the fan equipment that has what it takes.*" Write us, outlining your particular air handling or conditioning problem. . . . . .

COMPLETE AIR CONDITIONING
•
COOLING
•
VENTILATION
•
FACTORY HEATING
•
MECHANICAL DRAFT
•
FANS and BLOWERS for INDUSTRIAL NEEDS

CLARAGE FAN COMPANY – KALAMAZOO, MICH.
SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

MISTER..

CAN You SPARE A MINUTE ?

★ Today America has a big job to do . . . a job that thousands of factories throughout the nation are working at top speed to make sure will be done right and at the right time. Extra shifts have been added, overtime hours have been increased, production has been stepped-up to an all time high.

★ The only thing that is needed now to keep American industry in a smooth constant stride is patience. Doing with what we have until supply and material orders can be filled . . . having the same patience with producers that we expect from our own customers.

★ Here at Viking we've run up against a few delays in shipments, we've been confronted with the scarcity of some materials . . . but we've found that by careful planning, patience and a lot of hard work, everything has worked out fine. We're all in the same boat and sparing a minute now may avoid sparing trouble tomorrow.

VIKING

PUMP COMPANY

CEDAR FALLS, IOWA

ers. Capital classifications are also included for each company, covering number of employees and other pertinent information.

Special sections are devoted to descriptions of the various societies in New England, the Engineering Societies, Inc, the New England Council. Associated Industries of Massachusetts, etc.

INTERAMERICAN STATISTICAL YEARBOOK (1940). *Edited by Raul C Migone. Published by the MacMillan Co, 60 Fifth Ave, New York, N. Y. 612 pages, cloth bound, 8½x11 in. Price $6.00.*

This work presents in one volume a compilation of statistical facts from every country of North, Central and South America, with data from many European and Asiatic countries, included for comparison. Contains facts and statistics on population, production, industrial activity, trade, social questions, transportation and communication, banking and investment, public education, international cooperation, etc. Figures cover various years and include all available data of 1939.

As this yearbook was published to serve all American countries, the material is presented in four languages; Spanish, English, Portuguese and French. Each chart has title, notes and explanation in these languages, as well as the introduction and table of contents.

Brief Reviews

REPORT ON 'MULSIFYRE' PROJECTORS. *Published by Grinnell Co, Inc, Providence, R. I. Well illustrated, 77 pages, diagrams. Available on request.* —Describes emulsification system for extinguishing oil fires with water alone. Contains installation diagrams for transformers, turbines, oil switches, circuit breakers, oil pipelines, oil coolers, open tanks and ships. Of interest to all with responsibility for control of oil fires.

NEMA MOTOR AND GENERATOR STANDARDS. *Publication No. 41–24. Published by the National Electrical Manufacturing Association, New York, N. Y. Price $3.50.*

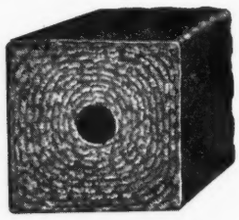
Revision of previous publication contains all standards which have been approved to date, covering motors and generators, including such information as standard dimensions, rating, tests, etc.

COLLINS MECHANICAL PACKINGS

COLLINS

BLACK CORE HIGH PRESSURE

ROD PACKING



The choice of *master mechanics* who keep their plants at top production efficiency.

It is a closely woven asbestos cloth wrapped around a non-vulcanizing rubber core; thoroughly lubricated, pliable—for use against High Pressure Steam, Oil, Acids, Air, etc. Will not score rod, harden or blow out. Also made of a wire inserted cloth for extreme conditions, especially for hot oil valve stems and similar service.

Furnished in all sizes ¼" and larger, varying by sixteenths—Ring, Spiral, Coil. Collins High Pressure Rod Packing also furnished in Rubber Back and without core.

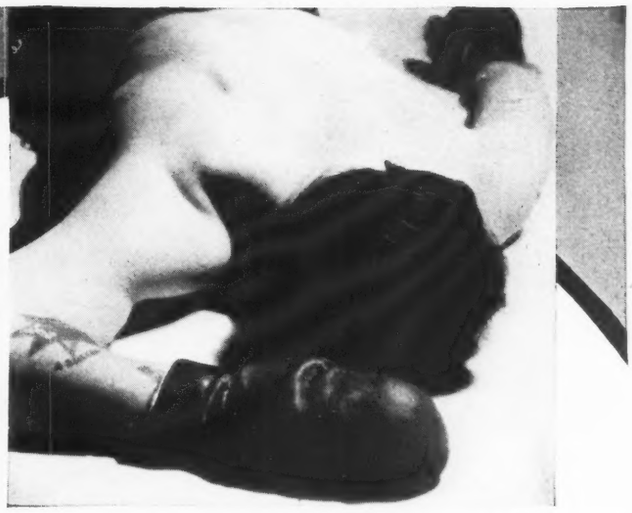
★ IN COLLINS MECHANICAL PACKINGS — *precision made for every need — there is loyal, patriotic purpose to protect production. Concerns which use COLLINS are set for "all out" to protect the life-line of liberty — the Production Line.* ★

COLLINS PACKING CO., INC.

Mechanical Packings

General Offices 401 No. Broad St.

PHILADELPHIA



KNOCK OUT DUST!

The Thermix Controlled Multicyclone is guaranteed to collect 98% of all pulverized coal fly ash coarser than 325 mesh. Repeated tests on field performance indicate that this high grade performance is even exceeded.

On large units operating in the field, elutriation tests of dust escaping indicate the average size of particle to be in the neighborhood of 8 microns.

This is quality collection, and with pulverized coal dust of the fineness usually encountered, gives an overall collection of 90% or better.

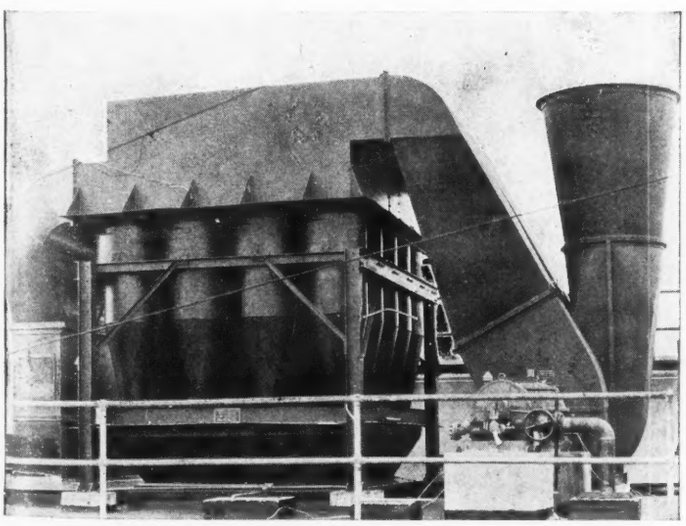
High efficiencies are maintained throughout the operating range with the Thermix patented method of control, which assures high efficiency at low loads where lack of velocity usually reduces the efficiency on mechanical collectors.

Our service in this field extends over a period of sixteen years. Our engineers are at all times ready to assist in solving your dust problems without cost or obligation to you.

Write for Catalog 105 and full particulars, or mail the coupon.

PRAT-DANIEL CORPORATION
88 S. Water St., Port Chester, N. Y.
Representatives in Principal cities

THERMIX
CONTROLLED
Multicyclone



Group showing relatively small space occupied by 20 units of Thermix Multicyclones

MAIL COUPON TODAY!

PRAT-DANIEL CORP.
88 S. Water St., Port Chester, N. Y.

Without obligation on our part, you may send us your catalog No. 105.

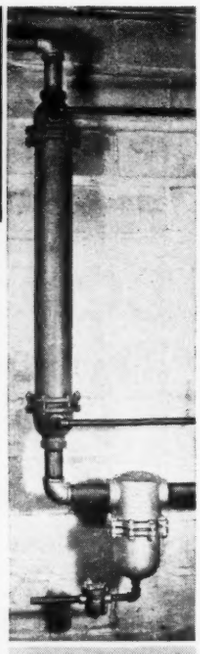
NAME .....

ADDRESS .....

CITY..... STATE.....

(C)

IT PAYS
to remove water, dirt and oil from Compressed Air



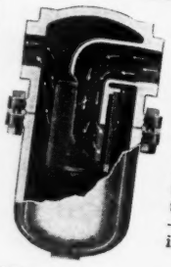
OPERATING records show that the Johnson-Gast Separating Devices described below actually pay for themselves in dollars saved. They prevent rusting and fouling of pneumatic machinery, and rapid deterioration of air hose. When compressed air is used for services like paint spraying they guard against imperfect results caused when moisture and dirt are entrained in the air.

For Steam Service, too.

The Johnson-Gast line also offers an easy way to remove water, dirt and oil from steam lines. This is particularly important where steam is used in food industries, breweries and other process plants. In many cases Johnson-Gast Separators are used to purify the exhaust from steam driven boiler feed pumps, so the condensate can be safely returned to the boiler.

THE JOHNSON CORPORATION
865 Wood St., Three Rivers, Mich.

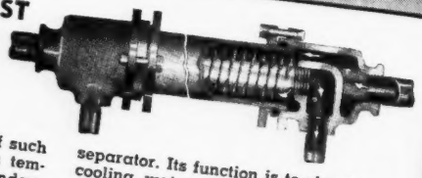
Here is the team that removes 99% of all water, dirt and oil from compressed air.



The JOHNSON-GAST Separator

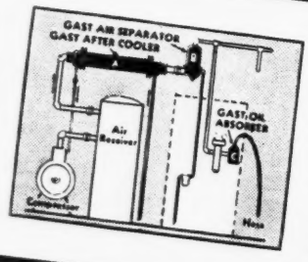
• This simple, long-lasting separator removes more than 99% of all water, dirt and oil from compressed air or steam. Its unusual efficiency arises from the fact that it combines the two most effective principles of separation —expansion and change of direction. First the air or steam is allowed to expand, thereby precipitating most of the foreign matter contained. Then it passes through the "thousand baffles"—a labyrinth of coarse wire mesh —changing direction of flow many times and surrendering the remaining particles of moisture and dirt.

The JOHNSON-GAST Aftercooler



• When moisture in the air is vaporized by the heat of the compressor, or where air is used under conditions of such velocity and pressure that its temperature remains above the condensation point, the Johnson-Gast Aftercooler is installed ahead of the separator. Its function is to circulate cooling water around the air line, and so condense all moisture so the separator can remove it. Note the simple, compact construction.

The JOHNSON-GAST Oil Absorber



• The Johnson-Gast Oil Absorber is used for those services where every final trace of oil must be removed—as in spraying of lacquers and enamels. It soaks up oil like a blotter, and one inexpensive filling lasts for many months. The drawing at left shows such a system in which the Oil Absorber is used, in conjunction with the separator and aftercooler—a system that assures an absolutely clean, dry, oil-free discharge.

WRITE for comprehensive Bulletin showing sizes and capacities of all Johnson-Gast Separating Devices.

JOHNSON-GAST
Separators • Aftercoolers • Oil Absorbers

RESULTS OF MUNICIPAL ELECTRIC SYSTEMS (1941). *Published by Burns & McDonnell Engrg Co, Kansas City, Mo. 428 pages, charts, graphs. Price $5.00.* Electric rate book shows operating records of earnings, output, rates, revenues, valuation and other information as to cost and use of electricity in 758 municipally owned systems.

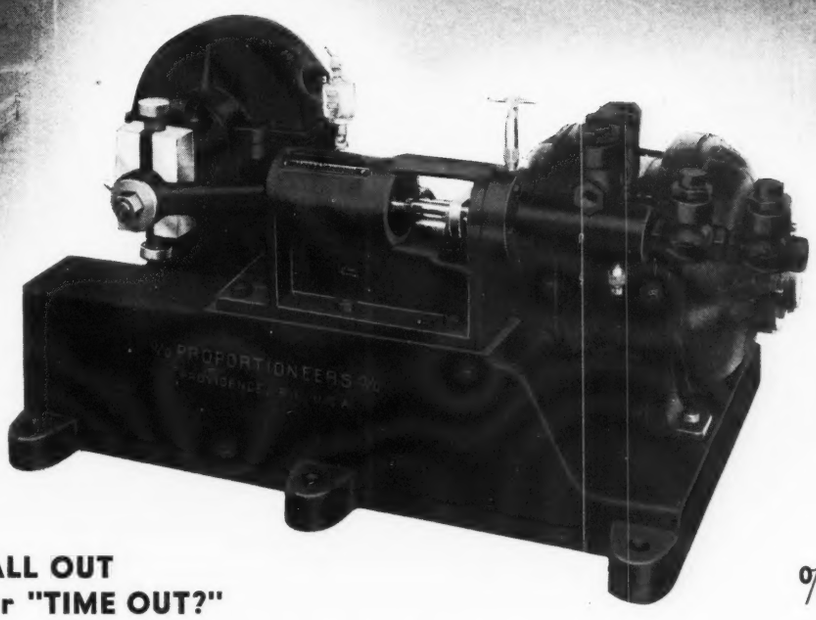
ENGINEERING INDEX (56th Annual volume 1941). *Published by Engineering Index, Inc, Engineering Societies Bldg, 29 W 39th St, New York, N. Y. Price $50.00.* Contains some 26,000 annotations of important articles that have appeared in domestic and foreign current technical periodicals, with about 40,000 cross-references to same. Also includes author and contributor's index of about 19,000 names. All branches of engineering included.

PRINCIPLES AND PRACTICE OF HEAT TREATMENT *by J Winning, Dipl RTC. Published by Emmott & Co, Ltd, 31 King St West, Manchester, England. 100 pages, drawings, photographs. Price about $.40.* According to the author, this book is an attempt to bridge gap between the theoretical developments of metallurgy and their practical applications. Representative alloys covered thoroughly.

ANALYTICAL AND EXPERIMENTAL STUDY OF THE HYDRAULIC RAM *by W M Lansford and Warren G Dugan, Engineering Experiment Station. Published by the Experiment Station, University of Illinois. 70 pages, paper bound, charts. Price $.70.* Purpose of investigation was to make rational mathematical analysis of the operation of single-acting hydraulic rams, and to compare results of such an analysis with those found from an experimental investigation of the rams.

FATIGUE TESTS OF WELDED JOINTS IN STRUCTURAL STEEL PLATES *by W L Wilson, W H Bruckner, J V Coombe and R A Wilde, Engineering Experiment Station, University of Illinois. Published by the Experiment Station, University of Illinois, Urbana, Ill. 86 pages, paper bound. Price $1.00.* Tests described were planned to determine fatigue strength of butt welds in 7/8-in. carbon steel plates of structural grade, relative fatigue strength of welded and riveted joints in low-alloy plates of structural grade, effect of frequent periods of rest upon fatigue strength of butt welds in carbon-steel plates of structural grade, and the effect of transverse fillet welds upon fatigue of plates. Fatigue tests were sup-

Get Positive Protection

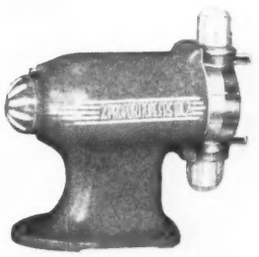


against

BOILER SCALE, CORROSION *and* EMBRITTLEMENT *with*

% PROPORTIONEERS %
Heavy Duty Chemical Feeders

There is a %Proportioneers% Chemical Feeder to fit YOUR requirement.



All hydraulic Chem-O-Feeder for direct drive from reciprocating boiler feed pumps. 5 gph capacity.

ALL OUT or "TIME OUT?"

To maintain peak production we must safeguard against plant shutdowns.

Scale, corrosion and embrittlement, due to improper treatment of boiler feed water, cause many costly plant shutdowns. This condition can be avoided if correct treatment and reliable feeding equipment are used. %Proportioneers, Inc.%—after years of field experience—have solved the chemical feeding problem with a complete line of apparatus specifically designed to insure maximum accuracy, dependability, simplicity, and low operation cost in boiler water conditioning.

%Proportioneers% complete chemical treating and feeding methods for the power plant include the handling of phosphates, sulphites, sulphates, sulphuric acid, etc. by:

1. *Constant rate* Adjust-O-Feeder for low, medium, and high pressure service for general water treating.
2. *Shot feed* Adjust-O-Feeder with manually adjustable time cycle and back flushing control for phosphates.
3. *Flow-proportional* Adjust-O-Feeder or Treat-O-Unit with control from—(a) reciprocating boiler feed pumps—(b) electric motor-driven control from either mechanical or Venturi meters.

And now look at these new important construction features:

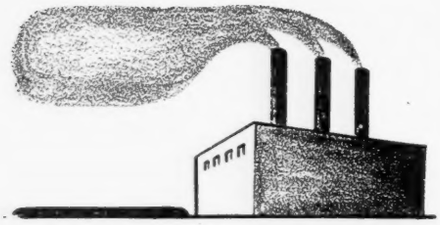
1. Oversize cross head guide with drip feed lubrication and visible stroke length scale.
2. Oversize micrometer screw for ease in adjusting exact crank throw.
3. Heavy Torrington needle bearings on both crank pin and wrist pin. Crank pin has hardened replaceable inner and outer races; wrist pin is automobile standard case hardened with replaceable outer races.

Over 4000 %Proportioneers% units are now serving industry.

Write today and let us send recommendations covering your chemical feeding problems. Ask for SM 122.

% PROPORTIONEERS, INC. %

16 CODDING STREET • PROVIDENCE, R. I.



Try This Quick, LOW-COST WAY of Increasing Coal Handling Facilities

Pile and Reclaim Coal with LeTourneau Carryalls

1. Save 50 to 75% on Original Equipment Investment—**LeTourneau Scrapers are comparatively low in first cost, eliminate the need for draglines, overhead structures, stationary drags and most one-purpose conveyors.**

2. No Installation Delays—**You can go to work immediately with a LeTourneau Scraper. It will level the storage area, haul and store the coal, and reclaim and re-haul to bunkers and hoppers later.**

3. Cut Handling Costs—**LeTourneau Scrapers load directly from rail or dockside . . . haul and spread 25 to 200 tons hourly, depending on scraper size and length of haul. They reclaim the coal, too, have cut out extra operating equipment in the plants of many large users.**

4. Eliminates Fire Hazard—**LeTourneau Scrapers store coal in thin, even, horizontal layers with fines thoroly mixed with coarse. Weight of unit traveling over coal closely packs pile, eliminates flues and thus reduces risk of spontaneous combustion.**

One man operates both tractor and scraper. This outfit, working for a large power plant in Michigan, hauls and stores 118.6 tons hourly.

Investigate the time and money-saving possibilities of LeTourneau Carryall Scrapers NOW. Ask your LeTourneau-"Caterpillar" dealer for further details . . . or write TODAY for colorful, explanatory bulletins. Address Dept. 9P.

LETOURNEAU

PEORIA, ILLINOIS • STOCKTON, CALIFORNIA

plemented with static tests and metallurgical studies.

BIBLIOGRAPHY OF RELAY LITERATURE —1927–1939. *Published by American Institute of Electrical Engineers, 33 West 39th St, New York, N. Y.* Covers list of articles dealing with protective relays and related subjects, compiled from the transactions of society and technical periodicals throughout the entire world.

TYPICAL ANALYSES OF BITUMINOUS COALS PRODUCED IN DISTRICTS 7 & 8—*Published as first of a series by Consumers' Counsel Div, U.S. Dept of the Interior, Washington, D.C. in cooperation with the Bureau of Mines. Price $.55 per copy.* Data Book, Volume 1 contains descriptive tables of rail- and river-shipping mines; maps showing their locations and analytical tables of seams by states and counties.

LEFAX DATA—*Published by Lefax, Inc, Philadelphia, Pa.* Recent Lefax data of interest to power men received are No. 37–25, "Materials Required Per Cu Yd for Concrete and Cement Mortar"; No. 41–6, "Conversion of Degrees to Mils and Mils to Degrees"; No. 12–427, "Solutions for the Orsat Gas Analysis Apparatus"; No. 3–13, "Low Pressure Air Flow Through Pipes and Orifices-Tables"; No. 41–8, "Gas Flow in Pipes"; No. 41–10, "Oil Flow in Pipes"; No. 41–9, "Gasoline Flow in Pipes"; No. 41–7, "Conversion Tables, Energy Units"; No. 13–44, "Wrench Head Bolts and Nuts"; No. 33–10, "Abbreviations for Scientific Engineering Terms"; No. 41–12, "Standard Form for Turbine Heat Balance"; No. 13–346, "Gallonage Tables"; No. 14–110, "Properties of Unequal Angles"; No. 10–210, "Symbols & Abbreviations Used in Chemistry"; No. 36–78, "Concrete Guide"; and No. 41–11, "Volume-Quality Enthalpy Chart".

PNEUMOCONIOSIS — THE STORY OF DUSTY LUNGS—*By Lewis G Cole and W G Cole, Published by the John B Pierce Foundation, New York, N. Y. 290 pages, cloth bound, available by request on company letterhead.* Comprehensive report covers subject of silicosis thoroughly, including history of dust-inhaling, problems of pneumoconiosis, dust flecks and their careers, classification by type, Roentgenology, and the social and economic aspects of the disease.

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By keeping abreast of the field's most up-to-date practices.

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By learning through the experience of other engineers important things you don't have a chance to learn in your present job.

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